THURSDAY, FEBRUARY 11, 1915.

THE REAL JAPAN.

Japan To-day and To-morrow. By H. W. Mabie. Pp. ix+291. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 8*s.* 6*d.* net.

THIS book makes little attempt to give the history of Japan or to describe the country or its political or naval and military development. It is, we think, a successful attempt to understand the Japanese temper, character, spirit, and genius. In material things the Japanese have altered altogether in the last sixty years, but in spiritual things they have altered very little. The traveller describing faithfully what he sees is usually ignorant of the things described in this book, but these are the things which it is most important for the statesmen of other countries to know. Mr. Mabie is an American, and he is anxious that Americans particularly shall look below the surface of things. He shows that the genius of a people eludes the direct search for it, and he looks for its revelation not in universities and courts, but in shops and fields and homes.

"It is a people whose government has been religious, whose religion has been governmental, and whose whole organised life has been like a garment woven out of the substance which it clothes, but does not conceal."

Customs have always had the authority of law. The soul of Japan is in Shintoism, which is no longer a religion; it is not only a living source of poetry, it is a profound national sentiment of tremendous energy. Strangers expressed only admiration for Japan forty or fifty years ago. As the Japanese realised that great resources were absolutely necessary for their existence, they turned to commerce and manufacture; then they were said to have become dishonest and their politeness had become insincerity. We have heard the same undiscerning kind of criticism of European people. The Japanese are in essentials just what they used to be. Their ways of thinking, their ideals, their standards of life, and their interpretations of the mystery of the world are different from ours, simply because for thousands of years they and we have lived unknown to each other. But these differences between us are only superficial, although Mr. Kipling holds another view.

The man who frequents the smoking-rooms of clubs and hotels cannot see the things described by Mr. Mabie, and ninety-nine per cent. of the business men who live in Japan and think they know all about it are quite ignorant of the intellectual movements, the spiritual stirrings in the souls of those among whom they have their home, but with whom they do not live. The Germans specially have shown contempt for the Japanese; even their highest classes have shown in this way their intellectual limitation. The parrot-cry that the Japanese have no originality—that they are merely imitative—comes from unobservant men. The Japanese have a passion for work; their hands and brains are always on intimate terms. One and all they are artists, and artists always possess freedom and the energy of personality. *Jiujitsu*, the endeavour to set skill against force and intelligence against mass is emblematic of one great characteristic of these people, which is perhaps most visible in their art, "the full weight of thought without any weight of expression." The Japanese will probably solve for Europe many of its seemingly insoluble problems.

This book is one that ought to be studied not only by people who wish to know something of the real soul of Japan, but also by all people who wish to keep their own souls alive.

JOHN PERRY.

LAMARCK'S EVOLUTION THEORY.

Zoological Philosophy: an Exposition with regard to the Natural History of Animals. By J. B. Lamarck. Translated by H. Elliot. Pp. xcii+410. (London: Macmillan and Co., Ltd., 1914.) Price 15*s.* net.

MR. ELLIOT has done a valuable piece of work in making a complete translation of Lamarck's "Philosophie Zoologique," which was published in 1809, half a century before Darwin's "Origin of Species," and is undeniably one of the evolution classics. He has enabled students of organic evolution who are unfamiliar with French, or who have been repelled by Lamarck's tedious style, to get a first-hand knowledge of the doctrines of one of the greatest of Darwin's predecessors. Recognising that the main interest of the "Philosophie Zoologique" is historical, Mr. Elliot has given a very literal translation, taking few liberties beyond breaking up some of the very long sentences, and altering words the meaning of which has greatly changed during the past century. A useful list is given of many of the French terms with the translations adopted. It must be confessed that there are many pages, especially those dealing with the classification of animals and with physiology, which are of little importance, but the value of having a complete translation is obvious. The alternative of making a selection of the salient passages is always a hazardous procedure. It seems to us that Mr. Elliot did wisely in translating the whole, and

that he has executed this laborious piece of work with care and skill.

As the author must have been saturated with Lamarck's views for a prolonged period, it is interesting to read his introduction, where the essentials of Lamarck's teaching are explained. We shall refer to a few. It is pointed out, for instance, that Lamarck's picture of a continuous scale of being from Monad to Man (the taxonomic punctuation being simply a matter of convenience) was associated with his denial that species had ever become extinct. Apparently peculiar fossils have, he maintained, their living representatives, though they may not have been discovered.

Reacting from the doctrine of fixity of species, Lamarck went to the other extreme of exaggerating their instability. Evolution he believed to have come about by minute steps only. The factors were two—an innate tendency to complexify and the hereditary accumulation of changes induced by peculiarities in function (use and disuse). These peculiarities may have arisen as responses to changes of environment, but he expressly excludes the direct action of the environment as an operative cause.

In discussing the question of the transmission of modifications, Mr. Elliot refers to an interesting and illuminating suggestion by Prof. MacBride that hormones may afford a clue to a possible *modus operandi* of transmission. Unless we have misunderstood, a similar suggestion was made by Mr. J. T. Cunningham in 1908, and the idea is also implied in a passage in the "Creative Evolution" by Prof. Bergson, with whose "illusions" Mr. Elliot is familiar. We refer to the point simply because these coincidences of thinking are always of interest.

Mr. Elliot says on p. 49 that if environmental factors come into action after birth or before it in the course of development they produce a *modification*, apparently *not* heritable. If they come into action before development begins, they produce a *variation* which *is* heritable. In his exceedingly important experiments on Simocephalus, Dr. W. E. Agar has shown that a change induced in the egg-cells along with the body of the parent had its influence on the individuals developing from these ova, and slightly on the next generation, and then waned away. In the light of this fact and Dr. Agar's interpretation, Mr. Elliot's view requires correction.

One of the interesting conclusions of Lamarck's physiology was that nervous impulse is due to a "nervous fluid," which is an "animalised" form of the electric fluid. He reached this conclusion by showing that no other theory worked, and Mr. Elliot finds obvious satisfaction in showing that this is the *per exclusionem* method used by Dr. Hans Driesch and others to prove the existence of a vital force or Entelechy. The fallacy is the familiar one that we have first to be sure that all the possible alternatives are before us. Mr. Elliot simplifies things by assuring us that "every event, that receives a scientific explanation, is analysed into some particular combination of matter and material energy." A reflex action, for instance, is "of a purely mechanical nature." But this, like the vitalist's declaration that there must be a "vital force," is an assertion that outstrips its evidence, as Prof. Sherrington's work plainly shows.

Lamarck was shrewdly opposed to postulating entities such as a vital principle or even "esprit," and was on the whole mechanistic. Yet we must bear in mind that one of the distinctive features of his teaching was the important evolutionary *rôle* which he ascribed to the "emotions of the inner feeling," which are excited by "needs," and give rise to actions at once satisfying and transforming. Of this and many other matters Mr. Elliot has much that is interesting to say, though we think his philosophy is sadly out of repair.

J. A. T.

GENERAL AND SPECIALISED GEOLOGY.

(1) *A First Book of Geology.* By Dr. A. Wilmore. Pp. vi+141. (London: Macmillan and Co., Ltd., 1914.) Price 1*s.* 6*d.*

(2) *An Introduction to the Geology of New South Wales.* By C. A. Süssmilch. Pp. xviii+269. Second edition. (Sydney: Angus and Robertson; London: Oxford University Press, 1914.) Price 7*s.* 6*d.* net.

(1) DR. WILMORE'S "first book" of geology presumably completes the admirable series that includes, under the care of the same publishers, the works of Prof. Watts and Sir Archibald Geikie, and culminates in the latter's monumental "Text-book." The landscape illustrations are clear and well chosen; we may specially mention Mr. Harrison's tors on Dartmoor, and the Sligo peat-bog, with Ben Bulben in the background, by Mr. Welch (of Belfast, not Dublin). Without any appearance of crowding, a remarkable amount of fundamental information is included here in 140 pages. Practical work is encouraged, and the book is well suited for schools. The fact that the dip is the greatest possible angle of those that might be read with the clinometer should be emphasised on p. 32. The fine picture of Vesuvius on p. 43 represents the well known eruption of 1872, not 1892. A figure 2 is missing from the olivine formula on p. 54; water is omitted from that for gypsum on p. 94;

and the use of the word "foliæ" and the classical derivations generally require revision. A new edition of so attractive a book will soon be called for. We note that such modern points of interest as the lava-plug of Mt. Pelée and the wanderings of pebbles from Ailsa Craig find a place in this lucid introduction to geology.

(2) Mr. Süssmilch's work on New South Wales is an enlarged edition of that published in 1911 (see NATURE, vol. xc., p. 590). It deals only briefly with surface-features, and is intended for readers who already possess a knowledge of general geology and of the terminology of the science. Such readers, we have reason to believe, are far more prevalent in colonies where mining development has been active than they are in our own islands, where exploration is practically complete. The success of Mr. Süssmilch's book indicates a good educational level in New South Wales. It is well illustrated by photographs, maps, and sections; among the last, those of the Permo-Carboniferous (late Carboniferous and Permian) coal-basins, in which glacial horizons occur, are of especial interest. The fresh-water conditions under which Triassic and Jurassic strata were deposited are dealt with in chapter xi., and the origin of the artesian water is touched on at the close. The latest publication, by the by, on this important and much-disputed question has been issued by the Department of Mines for New South Wales (E. F. Pittman, on "The Great Australian Artesian Basin"), and contains a detailed criticism of Prof. Gregory's views on the magmatic nature of the supply. Mr. Süssmilch "prefers at present to suspend judgment," and Mr. Pittman's paper, with its remarkably extensive bibliography, must now be consulted by those who are willing to go further.

The vegetation of successive periods in Australia is fully as interesting as the faunas. That of the Cretaceous period is known in New South Wales by conifers alone. The Glossopteris flora marks the Permo-Carboniferous horizons, while a Rhacopteris flora characterises the underlying Carboniferous beds (p. 89). We note that Archæopteris is quoted from the Lower Devonian estuarine shales of the Genoa River and from the Rhacopteris series in the Carboniferous. The author (p. 84) inclines to divide the "so-called Gympie beds," placing some of them, containing *Lepidodendron australe*, with the Lepidodendron beds of Devonian age.

The pictures of fossils are excellent, and the book is a pleasant addition to the growing library of the empire. Misprints are extremely rare; the spelling "Kosciusko" has long received geographical sanction. G. A. J. C.

OUR BOOKSHELF.

Logic, Deductive and Inductive. By Carveth Read. Fourth Edition. Pp. xvi+417. (London: A. Moring, Ltd., 1914.) Price 6*s*.

As this is the fourth edition—though enlarged and partly re-written—of the work under notice, it is not necessary to review it in detail. It is sufficient to mention, by way of reminder, that for the most part it follows the schemes of J. S. Mill and Prof. Bain, beginning with propositions and terms, and moving through the syllogism to induction, then dealing with causation, hypotheses, and fallacies. Perhaps the treatment of hypotheses might be noticed as specially interesting and good, the difference between hypothesis and theory being well brought out. Also, the nature of proof, *e.g.*, is very neatly put: "If a new agent be proposed, it is desirable that we should be able directly to observe it, or at least to obtain some evidence of its existence of a different kind from the very facts which it has been invented to explain" (p. 270). It is also well pointed out that science is a "way of thinking," and that though we inevitably follow perceptual analogies in our hypotheses—thinking of atoms and æther as perceptible things, which they are not—these hypotheses are useful even if wrong. There is no reason to be afraid of inventing an hypothesis. Ockham's razor may be too vigorously plied. We live by hypotheses in the affairs of daily life. If I lose my fountain-pen, I guess where it is, and then go to verify or disprove. So with science, the discoveries of which are often inspired guesses.

Oxford Outline Maps. Edited by Prof. A. J. Herbertson. (Oxford University Press.) Price 1*d*. net each, 9*d*. net for 12 of one kind, 1*s*. 4*d*. net for 25 of one kind.

THESE outline maps have been drawn for use in the exercises contained in the text-books of geography, of which Prof. Herbertson is the author, issued by the same publishers, but they will accompany usefully other modern class-books of geography. The maps are clear and well chosen, and are evidently the work of a cartographer familiar with the needs of schools.

Air, Water, and Food from a Sanitary Standpoint. By A. G. Woodman and J. F. Norton. Pp. v.+248. Fourth edition. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1914.) Price 8*s*. 6*d*. net.

THE first edition of this book, which was by the late Mrs. Ellen H. Richards and Prof. A. G. Woodman, was reviewed in the issue of NATURE for October 25, 1900 (vol. lxii, p. 620). The book was first written from a "missionary" point of view, but actually became used in colleges and technical schools, and the present authors have changed somewhat the character of parts of the volume. All the discussion on air and water has been rewritten, the section on milk has been recast, and numerous additions have been made throughout.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Penalty on Research.

WE are frequently told that there is no difficulty in being accorded the use of small quantities of absolute alcohol, duty-free. While professor at University College, it was possible for me to procure what I required, duty-free, for a permit had been granted to the college. Now, working in my private laboratory here, I am refused the privilege. Having applied for permission to be allowed to buy not more than two gallons a year of absolute alcohol, free of duty, the secretary, in a letter of February 1, says:—"The Commissioners regret their inability to grant you the use of pure spirit, duty-free."

Now, sir, I have lately been doing a good deal of work for various departments of the Government free of charge; and for some of this, absolute alcohol is, if not a necessity, at least a great convenience. Moreover, my laboratory servant, who is, by the way, a teetotaler, is serving with the colours.

I regard this action of the Customs Department as a penalty on research. No doubt it will be said, if an exception (exception to what?) is made in one case, why not in all? The privilege might be abused. I think not. Such a permit might be granted only to persons who are known to be actually engaged in research, and whose *bona fides* is attested.

The question of free alcohol is, you will observe, still unsettled; and I hope that some action will be taken to put an end to such folly. WILLIAM RAMSAY.

Beechcroft, Hazlemere, Bucks.

The Spectra of Helium and Hydrogen.

IT has become a general supposition that the validity of Bohr's theory of the spectra of hydrogen and helium would be definitely proved if certain faint components very close to the hydrogen lines given by Balmer's formula could be found experimentally. On the other hand, if the components were not found after exhaustive search, the theory would be disproved. This supposition is quite incorrect, and in view of the remarkable paper by Mr. E. J. Evans in the current number of the *Philosophical Magazine*, which describes the successful discovery and measurement of these components, it becomes a matter of urgency to indicate at once why such components can give no test of any theory of spectral production.

Into the vexed question of the agent producing the line λ 4686, and the Pickering series—whether it be hydrogen or helium— it is not necessary to enter, for the conclusions are the same in either case. We have two alternatives to consider: (1) that the lines are due to helium, and (2) that they are due to hydrogen. Let us, in the first place, take the first alternative, which has been rendered so probable by Fowler in his recent Bakerian lecture. In that case, the line λ 4686 belongs to an enhanced line series with 4N as the Rydberg constant instead of N. It is strictly analogous, as Fowler points out, to his new series of magnesium, commencing with λ 4481, and we must expect an analogous behaviour. Now no spectroscopist questions to-day the universal validity of the combination principle in spectra, developed by Ritz and Paschen, and some well-defined types of combination series are known. In particular, there is a well-marked spark series in magnesium formed by combinations of the type $3f-mf$, in the usual notation, where nf is the variable part of a line in the "4481" series. In other words, the wave numbers in this series—a comparatively strong one—are differences of the wave numbers of lines in the "4481" series. Fowler has measured seven successive members of this series (Bakerian Lecture, p. 253). If we calculate the corresponding series for helium from the "4686" series, we obtain precisely the Pickering series and the new components measured by Evans. This calculation is independent of *any* theory of the production of series. One series must necessarily be accompanied by the other. In this particular combination, the result is even independent of any expression, empirical or otherwise, of the series by a formula. The difficulty of observing the lines in no way contradicts this necessary origin. They may have another origin in addition, and be really twofold, but since this process must produce them even in the absence of any other, their existence cannot in consequence contribute to the establishment either of Bohr's or of any other theory.

The second alternative is to return to Rydberg's view that half the "4686" series is a principal series of hydrogen, and that the other half is a new principal series. The writer must here insist that he is not expressing a belief in Rydberg's view, though, in his opinion, sufficient justice has not been done to this alternative, which, from the point of view of exact formulæ, is not really inferior to the other, although the need for the presence of helium in the experimental isolation of the lines is against it. The important point is that even if this now somewhat discredited view is correct, the new components near the hydrogen lines must exist, and in *exactly* the same calculated positions as before. They exist again as combination tones, of the type $3P-mP$, where P is now the principal series of hydrogen, and can be calculated at once by subtracting the wave numbers of the "4686" series, or, in fact, of just the half of it which Rydberg designated as the principal series. This combination from the principal series is well known in the alkalis lithium and sodium, just below hydrogen in the periodic table. The lines could only be expected to occur, however, when λ 4686 is strong, as in the experiments of Evans.

While, therefore, the isolation of these lines is a great step in the advancement of our knowledge of hydrogen or helium, it cannot prove that they are helium lines, and although they were predicted by Bohr's theory, they were, in fact, previously predicted by the very existence of the "4686" series, whatever its interpretation. While sharing the general admiration for the great simplicity of Bohr's theory as applied to the Pickering and "4686" series, the writer must nevertheless point out the one, and apparently the only, method by which he believes it can be proved or disproved. This is by interference measurements of the first four or five lines in the "4686" series, from which the value of Rydberg's constant can be calculated exactly, and compared with Curtis's value for hydrogen. The lines are not at present measured accurately enough for this purpose.

J. W. NICHOLSON.

University of London, King's College, February 4.

On the History of a Notation in Trigonometry.

THE interpretation of formulas in the trigonometry of plane and spherical triangles is greatly simplified by the expedient of designating the sides by the same letters, respectively, as the angles opposite those sides

—one group of letters being capitals, A, B, C, and the other group small letters, *a, b, c*. The introduction of this notation is ascribed by Moritz Cantor, in his "Geschichte der Mathematik," vol. iii., 1901, p. 561, to the Swiss mathematician, Leonhard Euler, who first used it in 1753 ("Histoire de l'Académie de Berlin, Année," 1753, p. 231). It is the purpose of this note to point out that this simple, yet important, innovation was made nearly a century earlier.

In the British Museum there is a pamphlet of a dozen small leaves, written in Latin. Upon one side of each leaf there is engraved writing (script). The pamphlet is a collection of formulas for plane and spherical triangles, with drawings. Apparently the process of engraving was resorted to because no type was available for the new symbols used. There is no title-page. The first page contains "Symbola," and, at the bottom, the name "Ri: Rawlinson." The place and date of publication are not given. On one sheet, which is larger than the rest and is folded, there are drawings and time-records to illustrate the passage of the moon over the disc of the sun in an eclipse of January 16, 1655, observed at Oxford. Here the name "Ri: Rawlinson" occurs a second time. Who was this man? It could not be Richard Rawlinson, the antiquarian, for he did not write on mathematics. There is no doubt that the author of the pamphlet is the Rawlingson of whom Anthony A. Wood speaks in his "Fasti Oxonienses," edition P. Bliss, second part, London, 1820, p. 257, placing him in the Oxford list of "Doctors of Divinity" of the year 1661. The reference is as follows: "Sept. 9. Rich. Rallingson or Rawlingson of Queen's coll. chaplain to the duke of Newcastle, was created while the chancellor held the supreme chair in convocation.—He was an ingenious man, well skill'd in the mathematics, but had not preferment confer'd on him equal to his merits. He died in 1668, being then, as I conceive, rector of Pulborough in Sussex."

Thus it appears that the pamphlet was issued between 1655 and 1668. Some of the symbols are the same as those used by Seth Ward, Savilian professor of astronomy at Oxford, in his "Idea trigonometriæ demonstratæ," 1654. All of Ward's symbols were probably originally due to William Oughtred. Ward and Rawlinson used Oughtred's symbols for proportion, A . B : : C . D; they used a slightly modified form of Oughtred's symbols for "maius" and "minus"; they designated by *b'* the complement of an angle *b*. Rawlinson introduced several new symbols. In case of triangles, he designated the sides by the capital letters, A, B, C, and the opposite angles by *a, b, c*, respectively. This is his most important innovation. The idea of this device was not generally adopted until re-introduced about a century later. Rawlinson went even further. With him, A was the maximum side, C the minimum. Moreover, he distinguished in his notation between plane and spherical triangles by writing the letters in different script. Each letter for spherical triangles was curved in all its parts; each letter for plane triangles had a conspicuous straight line as a part of itself. Rawlinson had symbols for angulus "obliquus," "acutus," "obtusus," "rectus," and "rect. et obl."; he had symbols also for "datum," "latus," "complementum," "compl. com.," "latus op. angu.," "angu. op. lat.," "pars media," "quæsitum," "quadrans," "sinus," "tangens." Rawlinson's symbols for "parallelus," "perpendicu.," "triangulum," "radius" had been introduced into mathematics before 1655, and are still in use at the present time. His pamphlet lays extraordinary emphasis upon the use of symbols. He had what Thomas Hobbes called a "scab of symbols."

During the first half and middle of the seventeenth century British writers introduced symbols into trigonometry to an extent unparalleled by contemporaneous writers in other countries, but our histories of mathematics do not reveal this fact.

FLORIAN CAJORI.

7 Gordon Street, London, W.C.
January 30.

Measurements of Medieval English Femurs.

IN a paper lately contributed by Dr. Alice Lee to *Biometrika* (vol. x., Nos. 2 and 3, November, 1914, p. 208), entitled a "A Table of the Gaussian 'Tail' Functions," the author does me the honour to criticise some statistics which I published in the *Journal of Anatomy and Physiology* (vol. xxxviii., p. 238), on the measurements and proportions of the medieval English femur, derived from the study of bones in the crypt of the Parish Church at Rothwell in Northants.

The criticism, which is undertaken from the point of view of the advanced mathematician, I am ashamed to say I can only partly follow, but it turns largely on the very difficult question of accurate sexing, and Dr. Lee brings forward mathematical reasons for believing that my sexing must be inaccurate.

That this may well be so I readily allow, though I am glad to see that when Dr. Lee has rearranged the sexes to suit mathematical requirements, the average measurements seem to be altered by only the fraction of a millimetre, an amount of no possible importance to the practical anatomist or anthropologist.

There is, however, one method of criticism against which my practical experience in crypts makes me anxious to warn mathematicians; it is the futility of expecting that the measurable bones in a crypt will show any proportion to the number of males, females, and children in the population.

Owing to their greater fragility the children's bones become disintegrated in the course of centuries long before those of adult females; while, for the same reason, those of females do not last as well as those of adult males.

Consequently, when Dr. Lee points out that my method of sexing would mean a predominance of 79 per cent. of males in the population, while hers would give a slight preponderance of females, I submit that my estimate is, in the circumstances, more likely to be in harmony with the proportions of measurable bones in the crypt.

If Dr. Lee could superintend the restacking of a crypt full of bones with a view to their preservation, as I have done on two occasions, she would be astonished at the load of damp bone meal and broken fragments which have to be returned to the churchyard. In this I am sure would be found the excess of female bones as well as most of the bones of the children, thus accounting for the preponderance of male bones left fit for measuring.

F. G. PARSONS.

St. Thomas's Hospital, S.E.

Pheasants and Gun-Firing.

ON December 16, in the morning, pheasants in the woods at Dunsby and Hacconby made the same loud cackling as those later on at Saxby, referred to in NATURE of February 4, p. 622; and keepers made the same remark that there was shooting out at sea. These places are within a few miles of whence I write —viz., Bourne, in Lincolnshire. H. COTTON SMITH.

The Abbey Vicarage, Bourne.

NOTES ON STELLAR CLASSIFICATION.*

III.

BEARING in mind what has been said about the origin of the special class of bright line stars, I give a diagram showing that they occur exactly where we should expect to find them if the suggested origin is a sound one.

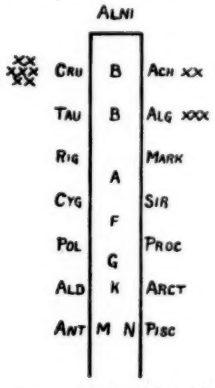

FIG. 5.—Position of the bright line stars at the top of the temperature curve.

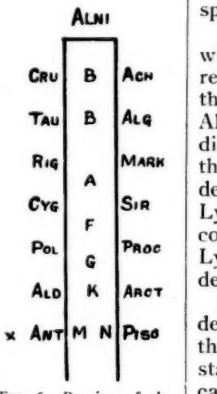

FIG. 6.—Position of the bright line variables at the base of the ascending arm of the temperature curve.

I return to that class of variable stars the changing luminosity of which, according to my hypothesis, is due to the heat and light produced by collisions between meteor swarms (Fig. 6).

Of these stars, in which the bright radiations have been recorded at maximum, one only, *o* Ceti, is included among the eighteen classified at Kensington as Antarian; 225 stars classified as Md (Antarian) are given on the Harvard List.[7] These are chiefly variables of long period. Prof. Pickering has obtained forty photographs showing bright lines, and ten stars have been discovered by means of this peculiarity of the spectrum.[8] Near minimum, when the star is faint, the bright lines are not seen.

There can be no doubt that all are physically similar, and that the position of all is at the base of the ascending arm of the temperature curve. That they are found here and nowhere else is an important test of the view that we have to deal with nebulous clouds consisting of discrete meteorites, as in comets, the gases from which produced by the heat supplied by collisions fill the interspaces at maximum and superadd the bright radiations to the fluting and line absorption seen at all times with varying intensity.

We next pass from these long-period variables with smooth curves, sometimes called "Mira variables," to another class with short periods, and with curves not so smooth, called "Cepheid variables."

The diagram Fig. 7 shows that these occur in the greatest number at a stage higher up the ascending branch of the temperature curve than the Miras. So far bright lines have not been recorded at maximum, but it has been noted that the position of maximum light energy moves towards the violet[9] as the star brightens. Their shorter periods, taken in connection with the fact that they must be more condensed than the Miras judging from their position on the curve, explains this difference of behaviour—there are no interspaces.

The Cepheid variables are not the only class without bright lines. I have already (Bull. I.) referred to the "eclipsing variables." Of these there are two classes, represented by β Lyræ and Algol, in which the shape of the curve is very different. This difference seems to arise from the fact that in the case of the Algols we are dealing with true discs, while in the case of the Lyras this stage has not been yet reached. These conditions are indicated by the position of the Lyras on the ascending and of the Algols on the descending arm of the curve.

Among the Piscian stars at the base of the descending arm we find a number distinguished by their irregular variability. In these we deal with a star rapidly dimming, surrounded by vapours of carbon giving absorption flutings, and of iron giving a multitude of absorption lines. The changes in the density of these vapours, to say nothing of the possible formation of scoriæ, are sufficient to explain the variation and irregularity in the light given out by these bodies. There are no interspaces to produce bright lines.

It is singular that some inquirers seem to regard the Antarian and Piscian stars (M and N) as being similar and so treat them as convertible terms,

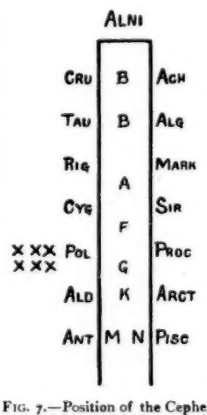

FIG. 7.—Position of the Cepheid variables halfway up the ascending arm of the temperature curve.

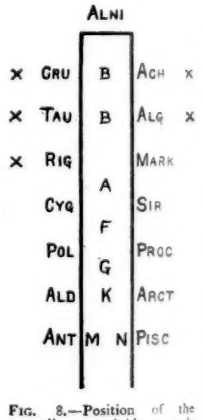

FIG. 8.—Position of the eclipsing variables towards the top of the curve.

while the fact is that the only similarity is their temperature. The following table will indicate their dissimilarities:—

Antarian.	*Piscian.*
Least condensed	Most condensed
Titanium absorption flutings	Carbon absorption flutings
Regular variables	Irregular variables
Bright lines	No bright lines

* Continued from p. 619.

7 *Annals*, vol. lv., pt. 1.

8 *Astr. Nachrichten*, vol. clxxxvii., p. 1.

9 Albrect in *Astrophysical Journal*, xxv., 332.

I have before referred to Miss Maury's *c* and *b* "divisions." It is interesting to see how the stars composing them arrange themselves on the ascending and descending arms. The facts are given in Figs. 9 and 10.

Prof. Ejnar Hertzsprung[10] has discussed the divisions of Miss Maury's classification, and while he finds that there is no systematic relationship between the *a* and *b* divisions with regard to spectral differences and differences of brightness, yet it is otherwise in the case of the *c* and *ac* divisions. The *c* stars, he finds, are very distant, and are extraordinarily bright. According to him (and previously according to Miss Maury) they seem to suggest different physical constitutions from the other divisions, and he terms them "whales," while the other stars he considers as "fishes." In his paper he gives a list of twenty-four *c* and *ac* stars. All of these included in my catalogue, with two exceptions probably due to errors of

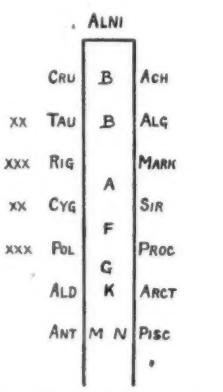

FIG. 9.—Position of the "*c*" stars on the ascending arm.

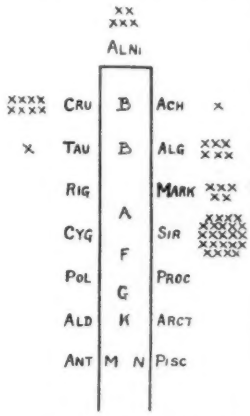

FIG. 10.—Position of the "*b*" stars at the top of the temperature curve and on the descending arm.

classification, fall on the ascending arm of the temperature curve (see Fig. 9).

They are thus found to be condensing swarms following in a natural sequence the more sparse swarms so rich in variables of the *o* Ceti type.

Their great luminosity is due more to volume than to temperature, and the special characteristics of the lines, as opposed to those of the *a* division, are due to the difference in absorbing conditions in sparse swarms and bodies with forming atmospheres, and also to the fact that the "solar" lines only occur in stars of lower temperature.

The stars of type "*b*," on the other hand, are seen to arrange themselves in an orderly sequence following on those of type "*c*" (Fig. 10). At the top of the ascending arm, where the sequence of *c* stars ends, the *b* stars come in, and extend round through the top of the curve down to the Sirian stage on the descending side. This sequence of the *b* on the *c* stars is a very suggestive one. As a *c* star approaches its maximum temperature, the physical conditions change from those giving rise to type *c* spectra to those from which spectra of type *b* are produced.

We are now in a position to derive some material results from the preceding considerations. In view of the definite manner in which the physical properties considered have shown themselves to be associated with the various groups on one arm of the curve or the other, we are justified in using these physical properties as criteria for locating stars on the ascending or descending arm of the temperature curve.

In the case of the constant bright line stars, Fig. 5 shows that considerations of their physical conditions may be made under the probability that all these bodies are in the neighbourhood of the maximum temperature attained during their evolution. Thus the twenty-six bright line stars mentioned earlier as being contained in the Harvard lists may be considered as being located on the temperature curve.

On the Harvard scheme, with the exception of classes M and N, stars may belong to either, as increasing and decreasing temperatures are neither recognised nor provided for. In classes M and N, as in my hypothesis, we are dealing with the bottoms of the ascending and descending branches, lowest temperatures and vastly differing conditions are involved. Hence we can classify as Antarian or Piscian all stars designated M or N on the Harvard system. We thus obtain from the Harvard Revised Photometry and the Second Catalogue of Variable Stars, about 650 and 70 of these two classes respectively.

Next, regarding the Cepheid variables, the Harvard Second Catalogue of Variable Stars contains thirty-four short period variables with approximately solar spectra. These are Cepheid variables, and may all be placed on the ascending arm, in conformity with the six already classified.

With regard to the eclipsing variables, those with continuously varying light-curves, like that of β Lyræ, will probably lie on the ascending arm of the temperature curve, and those like Algol may be expected to occur on the descending branch.

Finally we have to deal with the "c" and "b" stars. From the manner in which the ten of Miss Maury's Type "c" stars, which have been classified at Kensington, aggregate on the ascending arm, we may place the remaining nine given in her tables[11] in corresponding positions.

From the same source we find about ninety stars of Type "b." Those classified at Kensington are seen to cluster round the top of the curve, and to extend down the descending arm. Hence, when considering the physical conditions of those not so classified, we may regard them as occupying similar positions.

We are thus able to add nearly 900 stars to the 470 already classified on the temperature basis at Kensington.[12]

NORMAN LOCKYER.

[10] *Astr. Nachrichten*, vol. clxxix., No. 4296, p. 374.

[11] Annals Harv. Coll. Obs., vol. xxviii., part i.

[12] Catalogue of 470 of the brighter stars.

THE MANUFACTURE OF DYESTUFFS.

IN an article in NATURE of January 21, p. 555, the National Dye Scheme put forward by the Board of Trade Advisory Committee on December 22, 1914, was outlined, and in some of its aspects the development of dye manufacture in this country is of such far-reaching national importance that the subject claims the close and continued attention of all men of science. As stated last week (p. 621), the original scheme has now been replaced by modified proposals, the full details of which are not, however, yet available.

The outstanding feature of the new scheme is that the Government has undertaken to make a grant to the new company, for a period of ten years and to a total amount not exceeding 100,000*l.*, for the specific purpose of experimental and laboratory work, this grant being independent of the Government loan of a portion of the working capital of the company. Chemical research has thus officially been recognised and endowed as an essential factor in solving a national industrial problem; and this most important and far-reaching decision has everywhere been favourably received, and represents a permanent advance in public thought and official procedure. Probably the main factor in moving the Government to assist the development of dye manufacture is the fact that one and a half millions of workpeople are more or less dependent upon the continuance of the dyeing industry. While we realise these special claims to attention, we hope at the same time that similar practical steps will at once be taken to promote the development in this country of glass manufacture and other industries dependent for their success upon progressive scientific knowledge.

FIG. 1.—A German coal-tar colour factory.

The new dye company is to have powers to arrange for the assistance of a committee of experts conversant with the dyeing trade and its requirements. In the absence of details of the scheme, it does not appear that this proposal will adequately meet the claim that the technical expert should be largely represented on the directorate.

A perusal of the Press correspondence on the whole matter indicates that opinion has crystallised to some extent into a general agreement that the first aim should be immediately to develop and co-ordinate our existing manufacturing concerns, and encourage an increased output from Switzerland by arranging for the export of raw tar products to that country, and for transport facilities through France. But these expedients can afford only a very partial relief, and stocks of dyes are rapidly disappearing. It is therefore generally recognised as a matter of great urgency that the new manufacturing company should commence operations, and the first act of the company should be to devise an organised scheme of research on the initial problems of processes and yields.

One of the most instructive discussions of the problem facing the manufacturers of coal-tar dyes in competition with Germany is to be found in an address recently delivered by Dr. W. H. Nicholls before the Philadelphia meeting of the American Association for the Advancement of Science, and printed in *Science* for January 8 under the title "The War and Chemical Industry." Dr. Nicholls, speaking with the authority of one who has been for many years at the head of a large chemical organisation in the United States, throws some interesting sidelights on the reason for American inactivity in this field. American manufacturers were at first assured by "one of the large producers in Germany that it was absolutely certain that American coal did not possess the necessary constituents to make it useful as a basis for the production of organic chemicals." When, in spite of this discouragement, it was actually found that aniline oil could be made at a profit in the States, "down went the price below cost. A tariff of 10 per cent. which was put upon the article was immediately absorbed by the foreign makers, and the price became lower still." The result was that the infant industry ceased to exist, and has only come to life again since the outbreak of the war.

It is emphasised that "to take away the dye business from Germany means attacking the best equipped and the best income-producer of Germany's entire chemical and allied industry"—a branch which, in 1912, with a total capital of nearly 8,000,000*l.*, paid a dividend representing 22 per cent. of the capitalisation. The fact that German works have long ago written off the cost of their

plant, together with their acquired experience and their sales organisations, largely account for the almost complete control which Germany has acquired in this branch of industry, and these are insuperable difficulties to be met by any competing nation unless really effective State-aid is guaranteed in the future.

The accompanying illustration (Fig. 1) from the *Little Journal*, for December, published by Messrs. A. D. Little, of Boston, Massachusetts, shows a typical German coal-tar colour factory. Some idea of the development of the German dye industry is afforded by the history of the Farbwerke Meister, Lucius und Brüning, which was organised in 1862 by two chemists and two merchants, with a staff of five workmen, one clerk and one chemist, and an engine of three horse-power. In 1912 7680 workmen, 374 foremen, 307 chemists, and 74 other higher technical officials were employed by this single firm, the wages paid out being 8·6 million marks, whilst 5·2 million marks were expended in salaries and bonuses. Eleven thousand different substances were manufactured, and the steam engines had a total horse-power of 30,000.

Closely wrapped up with the question of the manufacture of aniline dyes in Great Britain is that of the future of indigo in India, which is discussed in an article in the *Pioneer Mail* of January 8. It is here emphasised that during the past few years the indigo grown in Bihar and Orissa has been falling off in a remarkable way owing to the competition of the synthetic dye; whereas in 1913 63,100 acres were under indigo, the area grown this year is only 38,500 acres. Owing to the war, however, the price of natural indigo has rushed up enormously to more than 700 rupees per maund, a rise of about 300 per cent. on the normal price of the past three years. Thus the few indigo planters who were still producing indigo have been fortunate enough to make very large profits, and if they can continue or increase their production during 1915 they will be in an equally strong position. It is, however, difficult to estimate the ultimate effect of the war upon the indigo industry of India. There is no doubt that trade with Germany will be suspended for some time to come, and some time must also elapse before the manufacture of the synthetic dye can be established in France or England. Moreover, the use of natural indigo will probably be stimulated, owing to the increased requirements of the War Office and Admiralty, so that for some time to come the indigo planters will probably benefit considerably and make profits which will be some compensation for the lean years recently passed through. But there is little doubt that in the long run the synthetic dye, whether manufactured here or in Germany, will very largely supplant the natural material; it will be a repetition of the history of the madder industry. On this side of the question reference may be made to the lecture delivered recently by Dr. F. M. Perkin before the Society of Arts, and published in the *Journal* for January 1, and to the discussion which this paper evoked.

METALS AND WAR.

CONSIDERABLE attention has recently been devoted to the internal resources of Germany as a producer of various metals, more particularly, of course, of such metals as play an important part in the manufacture of war material. It has been shown that the normal consumption in Germany of copper, for example, is about 250,000 tons yearly, whilst the production is only about 25,000 tons, of which 20,000 tons are produced from one mine alone, the well-known Mansfeld mine, so that the possibility of any great increase in the domestic production would appear to be remote. The bulk of the German copper is imported from the United States, which produces more than half of the world's supply of copper, amounting now to about one million tons per annum, so that in normal times Germany purchases about one half of the United States' output of copper. It is obvious that the American producers of this metal must be seriously affected by the loss of so very important a customer.

Although public interest has centred mainly upon copper in this connection, there are other metals of scarcely less importance in this respect; thus nickel is used in the manufacture of armour plate, of special steel for ordnance and numerous similar purposes, and for some purposes can even be used to replace copper, as in the casing of leaden bullets. Germany produces practically no nickel, but has to import all its requirements; it would appear that the imports of nickel and nickel ore, which latter is smelted in Germany, would represent between 5000 and 6000 tons of nickel, of which about 1500 tons is re-exported, so that the German consumption may be taken as approximately 4000 tons per annum, out of the world's total production of some 28,000 tons. Again, manganese is indispensable in steel manufacture. In round numbers, Germany produces about 85,000 tons of manganese ore, and imports normally 650,000 to 700,000 tons, the bulk of which comes from the Caucasus, so that Germany produces only about one-ninth of its normal requirements of manganese, and the cutting off of the supplies of this substance cannot but seriously affect its steel production.

NOTES.

IN answer to a question as to typhoid in the Army, asked in the House of Commons on February 8, Mr. Tennant, Under-Secretary of State for War, said:—"Of the 421 cases of typhoid in the present campaign among British troops 305 cases were in men who were not inoculated within two years. In the 421 cases there have been thirty-five deaths. Of these deaths thirty-four were men who had not been inoculated within two years. Only one death occurred among patients who were inoculated, and that man had only been inoculated once, instead of the proper number of times—namely, twice." This is a marvellous record; and no further answer than it provides is needed to the inhuman efforts made by anti-vaccina-

tionists to induce men to object to inoculation by which such protection is secured. Replying to some carping criticisms against inoculation made by Mr. Chancellor in the House of Commons on February 9, Dr. Addison pointed out that in the South African war there were 58,000 cases of typhoid—more than an Army Corps—whereas in our great force now in France and Belgium, and after six months, including three months of atrocious weather, there have only been 421 cases among our troops. The total losses in South Africa were 22,000, of which about 14,000 deaths were from diseases and 8000 of these were from typhoid. When we compare this immense sacrifice of human life from preventible disease with the record stated above, we can only wonder at the patience of the British people in permitting a prejudiced faction to urge men not to subject themselves to a treatment by which they save others and themselves from suffering and death.

PROF. G. O. SARS, professor of zoology, University of Christiania, has been elected an honorary member of the Challenger Society.

SIR W. WATSON CHEYNE will deliver the Hunterian oration at the Royal College of Surgeons, Lincoln's Inn Fields, on February 15, taking as his subject "The Treatment of Wounds in War."

DR. SIDNEY COUPLAND has been appointed Harveian orator (of the Royal College of Physicians) for 1915; Dr. J. Michell Clarke Bradshaw lecturer for 1915, and Dr. Samson G. Moore Milroy lecturer for 1916.

THE Secretary of the Admiralty announces that the King has approved the award of the Polar Medal to the officers and men who took part in the Australasian Antarctic Expedition of 1911–14, under the leadership of Sir Douglas Mawson.

IT is announced in the issue of *Science* for January 29 that the city of Philadelphia, acting on the recommendation of the Franklin Institute, Philadelphia, Pa., has awarded the John Scott legacy medal and premium to Dr. C. E. Guiliaume, of Sèvres, France, for the invention of his alloy invar.

ACCORDING to the *Southern Times* of February 6 the monument on the grave of the late Dr. Alfred Russel Wallace in the cemetery at Broadstone, Dorset, is a fine specimen of fossil tree from Portland, seven feet in height and weighing some two tons. The specimen stands on a foundation of Purbeck stone, and an inscription on it indicates merely Dr. Wallace's name and dates of birth and death.

DR. W. H. HADOW, principal of Armstrong College, Newcastle-upon-Tyne; and Engineer Vice-Admiral Sir Henry J. Oram, K.C.B., F.R.S., Engineer-in-Chief of the Fleet, have been elected members of the Athenæum Club, under the provisions of the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public service."

THE death is announced, in his fifty-eighth year, of Prof. L. L. Dyche, of the University of Kansas. He was a graduate of that institution, at which he was appointed in 1885 assistant professor of zoology, in 1886 professor of anatomy, in 1890 professor of zoology, and in 1900 professor of systematic zoology. He had made twenty-three scientific expeditions in various parts of North America, as well as Greenland and the Arctic regions, and had thereby secured for the University of Kansas one of the most valuable collections of mammals in the United States.

DR. BENJAMIN SHARP, who had charge of the department of zoology in Peary's first Arctic expedition, has died at Morehead, North Carolina, at the age of fifty-six. For a time he was professor of invertebrate zoology at the Philadelphia Academy of Natural Sciences, and afterwards at the University of Pennsylvania. He was then appointed corresponding secretary of the former institution, in whose interests he made collecting expeditions to the Caribbee Islands, Hawaii, and elsewhere. He was an industrious lecturer and writer on zoological subjects.

THE occurrence of frost-bitten feet among the troops has been reported from time to time. According to the *Morning Post*, February 5, Dr. Temoin, of Bourges, has investigated the subject, and concludes that the affection is not due to frost-bite, but is a gangrenous condition caused by arrest of the circulation through pressure, cold being a contributing but secondary factor. Wet causes the puttees to contract and retard the circulation, and the feet swell in consequence in the boots, which also somewhat contract. The remedy is to induce the soldiers frequently to take off their boots, and to reduce the period in the trenches.

IN a paper read before the Institution of Civil Engineers on February 9, Mr. F. D. Evans dealt with engineering operations for the prevention of malaria, as carried out in the Federated Malay States. Drainage is all-important, and an inexpensive and thoroughly efficient type of drain has been evolved to meet the conditions, formed of concrete blocks of half-egg shape, laid close but unjointed. The blocks are laid without foundations even on bad ground in flowing water. Should they move out of line or gradient, it is easy to re-set them correctly when the surrounding ground has settled, after which they give no trouble; but re-setting is rarely necessary.

A FEW weeks ago it was reported by cable that Sir Ernest Shackleton would not reach the base from which he intends to start his crossing of the Antarctic continent, in the Weddell Sea, in time to proceed this season. Letters and a diary now published in the *Daily Chronicle* confirm this. The ice has been very late in breaking. Sir Ernest now hopes to get away from the base at the beginning of November next, after wintering there. His present communications have come from South Georgia, and an interesting and useful piece of scientific work has already been done there in the erection of true meridian posts, which will enable whaling and other ships to test their compasses. The voyage to South Georgia appears to have been prosperous, and the expedition has

received an addition to its *personnel*, which must be unusual for a polar voyage, in the shape of a stowaway.

THE Calcutta correspondent of the *Morning Post*, in a communication dated January 7, states that the trustees of the Indian Museum, Calcutta, have addressed to the Government of India the following protest against the acts of vandalism perpetrated by the Germans in destroying Belgian museums and buildings of historical interest: "We, the office bearers of the Board of Trustees of the Indian Museum, desire to protest on behalf of our Board against the unnecessary destruction of libraries, art galleries, museums, and buildings of purely historical and artistic value in time of war. We do so with the knowledge that we have the support of our colleagues in other countries and with the conviction that the collective opinion of the governing bodies of scientific and artistic institutions throughout the world should be regarded as a matter of international importance, and that, on the conclusion of the present war, steps should be taken to lay down definite rules under international sanction for the preservation of artistic, historical, and scientific treasures during warfare."

THE North-East Coast Institution of Engineers and Shipbuilders has conferred its honorary membership upon Lord Fisher, First Sea Lord, in recognition of the part taken by him in bringing about the reform of the position of the rank and status of the naval engineer officer. In asking Lord Fisher to accept this honour the institution wrote: "It was with special satisfaction and pride that the council of this institution learned of the Admiralty order of the 24th December conferring military rank upon the 'old entry' engineer officers of the Royal Navy—satisfaction, in that it is believed that the change will lead to increased naval efficiency; pride, in the realisation of the fact that their professional brothers have won so honourable a recognition of their value in the constitution of 'our sure shield' the Navy. Our institution is convinced that it is chiefly to your lordship's keen perception of the dominating importance of engineering science and *matériel* in the constitution of the modern Navy that the nation is indebted for this wise and generous readjustment of the rank and status of naval engineer officers."

THE explosives industry has experienced a severe loss in the death of Capt. M. B. Lloyd, late of the Royal Artillery, and for the last seven years a director of the well-known firm of Messrs. Curtis's and Harvey. Born in 1865, Capt. Lloyd entered the Army from the Royal Military Academy in 1884, and in 1896 passed first out of the advanced class of the Ordnance College, obtaining the Lefroy gold medal and "honours" in practically every subject, including mathematics—a very rare distinction. On the death of Sir Vivian Majendie in 1898 he was appointed an inspector of explosives at the Home Office, and for a year or more was in charge of the recently established testing station for mining explosives on Plumstead marshes, where he did a considerable amount of useful work in connection with the risks due to the presence of gas and dust in coal mines, the experience he thus gained proving most valuable when he was subsequently appointed secretary of the Departmental Committee on "bobbinite." After leaving the Home Office early in 1908, and joining the directorate of Messrs. Curtis's and Harvey, Capt. Lloyd's exceptional qualifications led to his services being much in demand on technical committees; he was selected to represent the explosives trade on the War Office Committee on the Shipment of Explosives, on the Departmental Committee on the Heat Test, and on an informal committee appointed to consider the best form of construction for "danger buildings," and was made a member of the Home Office Committee on celluloid and its dangers. His premature death will cause a gap difficult to fill.

IN his paper on the "Fortified Headlands and Castles on the South Coast of Munster," reprinted from vol. xxxii., 1914, of the Proceedings of the Royal Irish Academy, Mr. T. J. Westropp has discovered an almost unexplored field in Irish archæology. These Irish coastal forts were constructed at various epochs. In some, like Howth, near Dublin, and Shanoan in Waterford, flint instruments have been discovered; some belong to the Bronze Age; others, again, were built or occupied by Danes, Welsh, or Normans. They differ greatly in form, and the following types are recognisable: simple headland forts with a single wall; complex, with several earthworks or walls; entrenchments or citadels; multiple forts with a single wall; complex, with several earth-with a gangway natural or artificial; headlands with a deep natural hollow at the neck; and fortified shore-rocks, usually isolated at high water. This interesting paper is well illustrated with photographs and ground plans. The completion of this investigation along the other parts of the Irish coasts, for which materials are now available, will be welcome.

IN the latest issue of the Anthropological Publications of the University of Pennsylvania (No. 1, vol. vi., 1914) Dr. G. G. Maccurdy has given an account of a collection of twenty-four skulls of the natives of the eastern end of New Britain—or, as the Germans have renamed the island, Neu Pommern. The natives of this island have heads which are very narrowly compressed from side to side, but in their general feature are clearly close relatives of the Australian aborigines. Dr. Maccurdy finds their canial capacity to be very low, the average for male skulls being 1345 c.c., for female skulls 1214 c.c. Apparently such an estimate depends on the material used in filling the cranial cavity, for Dr. Krause, employing millet as a measuring medium, in place of the shot used by Dr. Maccurdy, found the cranial capacity to be much lower for the natives of New Britain, viz., 1267 c.c. for males and 1180 c.c. for females. Dr. Maccurdy directs attention to a remarkable observation which Virchow made on three skulls from a common grave in New Britain. One was that of a man with a capacity of 2100 c.c., the other of a woman with a capacity of only 860 c.c. Virchow explained the difference as being due to the fact that the man had suffered from hydrocephaly, while the woman had been a subject of imbecility. It would be very in-

teresting to know if the great pathologist's explanation was really the true one—or if such a variation of brain capacity does occur among normal individuals of a native and untutored race.

THE *Journal of Anatomy and Physiology* for January, 1915, contains a paper by Dr. R. J. Gladstone and Mr. Erichsen-Powell on manifestations of occipital vertebræ and fusion of the atlas with the occipital bone in man. Four specimens of this variation are described, and its causes are discussed. Speaking generally, variation about a mean, with compensatory changes in other regions of the body, may be regarded as an established biological principle, which governs or acts on this region, as well as on growth and development in general. The authors are inclined to regard the majority of the variations in the occipito-atlantal region as largely attributable to this cause.

MESSRS. F. DAVIDSON AND CO., of 29 Great Portland Street, W., have sent us a descriptive pamphlet of the "Davon" super-microscope. The idea of this instrument was suggested by the principle governing the micro-telescope (described by Prof. Boys in NATURE, January 22, 1914), which is that of providing the microscope with an image *in air* of a distant object, the air-image being magnified by the microscope. This is accomplished by attaching a tube carrying a stage and focussing screw to the condenser-fitting under the stage of the microscope. The primary microscope slides into this tube, and consists of a tube with stops and an eyepiece and an inner tube, also stopped, carrying the micro-objective; this performs the primary magnification of the object and the image formed by the combination in air anterior to the eyepiece is then magnified by the microscope, to which it is attached, which is termed the "secondary" In this way almost unlimited magnification can be obtained, though, of course, resolution is unaffected thereby. For photomicrography no long-extension camera is required by this arrangement.

A RECENTLY published number of the *Annals of Tropical Medicine and Parasitology* (vol. viii., No. 3) contains a memoir on sleeping sickness in the Eket district of Nigeria, by Drs. Macfie and Gallagher. An endemic focus of sleeping sickness of considerable magnitude was found in this district, but the disease is of a mild type, occurring chiefly in children; the mortality is low, and spontaneous cures appear to be frequent. The trypanosomes can be found in the juice of the lymphatic glands, but have not been detected in the peripheral blood; the parasites differ in some respects, both in their morphology and pathogenic reactions, from the typical *Trypanosoma gambiense*, and the authors regard them as a distinct species (*T. nigeriense*, Macfie), characterised morphologically by the occurrence of a small percentage of peculiar diminutive stumpy forms. The infection is believed to be carried by *Glossina tachinoides*. The memoir is well illustrated, and in an appendix by Dr. Macfie it is shown that *T. pecaudi*, *T. pecorum*, and *T. vivax* are transmitted also by *G. tachinoides* in the Eket district. In another memoir in the same publication Dr. Macfie describes various blood-parasites collected by him in Nigeria. Amongst these are some organisms found in the blood of guinea-pigs and resembling the organism described by Seidelin from human blood under the name *Paraplasma flavigenum*, which is alleged to be the parasite causing yellow fever.

ACCORDING to a recent "count," as recorded in the *American Museum Journal* for January, the total number of fur-seals on the Pribilow Islands (where slaughter is now prohibited) in 1913 was 268,305—a large increase in the matter of "pups" over the preceding year.

IN the *Victorian Naturalist* for December last Mr. J. A. Kershaw, curator of the Melbourne Museum, recounts his experiences during a collecting trip to the Claudie River district, in the north of the Cape York Peninsula, Queensland. One of the incidents was a brief sojourn on Lloyd Island, where the party was much interested in the swarms of nutmeg-pigeons, Blue Mountain parrots, and shining starlings, which resort every evening to the island to roost, and return at early dawn to pass the day on the mainland.

MR. J. R. HENDERSON'S administration report of the Madras Museum and Aquarium for the financial year 1913–14 has been issued by the Educational Department for that Presidency. A feature of the year's work was formed by demonstrations in the museum given to local schoolboys; another series of demonstrations being also arranged for teachers. Specimens of three newly described Indian mammals were presented to the museum by the Bombay Natural History Society. The Marine Aquarium maintained its popularity, more than four thousand rupees being taken at the toll-gates. A slime-head (Ophiocephalus) and a ray (Trygon) bred during the year in the central fountain.

WE are indebted to the author, Mr. J. A. Hutton, for a copy of a report on salmon-netting in the Wye during 1914, reprinted from the December issue of the *Salmon and Trout Magazine*. There were expectations that the season's catch would be exceptionally good, but it proved very disappointing, the total number of fish being only 2842, as compared with 6408 in 1913. The catch was, in fact, the smallest taken since 1908. Since the resumption, after a three years' interlude of netting in 1905, there have been great fluctuations in the number of salmon annually netted in the Wye. During the first four seasons the take averaged 2330; in 1909 there was a rise to 4319, while in the next three seasons the average fell to 3304, to be succeeded, as already mentioned, by an unprecedented increase to 6408 in 1913.

WITH the assistance of the Imperial Institute efforts are being made to create a market in the United Kingdom for the ground nuts grown in India and West Africa and their products—oil and feeding-cake. The export of ground nuts combined amounted to more than seven million cwts. in 1912, of the value of nearly 4,000,000*l.*, and hitherto France and Germany have between them absorbed the greater part

of this supply. The cessation of trade with Germany, and the diminution of the French demand, placed Indian producers in a serious position, and though recently the mills at Marseilles have placed orders with India, the demand from France remains below the normal. A quantity of the nuts has recently been imported into Hull from India for the production of ground nut oil, which is suitable for use as an edible oil as well as for soap-making. Abundant supplies are available from India, and when all foodstuffs are rising in price it is important to remember that ground nuts yield not only oil and feeding-cake, but are also valuable for edible purposes. In the United States they sell as roasted peanuts, and in the form of "peanut butter." Blanched kernels are regularly used in West Africa as a vegetable, mostly in the form of ground nut soup, but there are a variety of other ways in which ground nuts, which are both palatable and highly nutritious, can be prepared for the table.

In Bulletin No. 10 issued by the Agricultural Department of the Armstrong College, Newcastle-upon-Tyne, Prof. Gilchrist records the results of rotation experiments made at Peepy in 1910–13, and brings out a point of special interest to both the farmer and the man of science. Three plots received farmyard manure stored for different times at the rate of 12 tons per acre. The various forms of dung were: (1) fresh; (2) dung kept just long enough to be in good condition for application; and (3) old dung stored in a heap for some months. The best return from the four crops of the rotation was given by the manure kept for a short time only before it was applied. The old manure gave a rather better return than the fresh dung. The effect of the different dungs was naturally shown most clearly by the swedes, the first crop of the rotation, on which the dung kept for a short time only (2) showed a gain per acre 65 per cent. better than the old dung (3). This striking difference may be attributed to the heavy loss of readily available nitrogen and phosphate which occurs in farmyard manure when stored in heaps exposed to the weather. Recent laboratory experiments by Löhnis and Hunter Smith showed that fresh dung stored for periods varying from one to twelve weeks and then mixed with soil, subsequently nitrified at very different rates. As the optimum period of storage indicated by these workers was four weeks, it would be interesting to know exactly how long the manure used in Prof. Gilchrist's most successful experiment was kept before application to the plot.

The Monthly Weather Report issued by the Meteorological Office for December, 1914, is of more than ordinary interest, due to its reference to rain, floods, and gales. The frequent and abundant precipitation in many parts of England is said to be without a December precedent. The effects were the more marked because it followed a wet November, resembling the wet spells in 1876 and 1911. Many gales occurred during the month, and some were of great violence, whilst the atmospheric pressure was lower on the whole than in any December since 1876. December 23 and 24 were the only days when the pressure distribution over the country was not cyclonic. Temperature was generally above the normal until December 18, but afterwards it was generally below the normal. The rainfall exceeded the average in all parts of the kingdom, whilst the excess was abnormal over a large area in England. At Kew Observatory the total is quoted as 6·37 in., and was the highest December value since the record began fifty-nine years ago. At Greenwich Observatory the total was 5·96 in., and was the highest December value in the last one hundred years. It is mentioned that at many stations the percentage exceeded 300, the most notable being along the south coast of England and in the Isle of Wight. The highest values given are 331 per cent. of the average at Worthing, 354 per cent. at Totland Bay, and 415 per cent. at Hawarden Bridge. An aurora was observed at Newton Rigg on December 26.

In *L'Elettrotecnica* for October 5, 1914, Lo Surdo gives a complete review of the work done by J. Stark and himself on the electrical analogue of the Zeeman effect, *i.e.* the splitting up of the hydrogen lines of the spectrum by the intense electric field in the Crookes dark space. A brief account of Lo Surdo's experiments was given in Nature for May 14, 1914 (vol. xciii., p. 280). Making use of Stark's observation that the separation of the components is proportional to the field strength the author now seeks to determine the distribution of the field in the dark space. If the discharge tube is parallel to the collimator slit, it is found that the red hydrogen line is transformed into a Y-shaped figure, the upper end of which corresponds to the space nearest the kathode. It is, therefore, concluded that the field intensity decreases more or less uniformly with the distance from the kathode. This agrees roughly with Schuster's direct measurements, but is altogether opposed to those of Graham, who found points of maximum and minimum intensity. It may be remarked that the author appears to be unacquainted with the excellent measurements of Aston on the same subject.

Recent publications of the U.S. Coast and Geodetic Survey include the results for 1911 and 1912 from the magnetic observatory at Vieques, Porto Rico, and the annual report on field magnetic work for 1913. The former publication, in addition to diurnal variations of the magnetic elements relating to local mean time derived from the ten quietest days of the month, now contains diurnal variations relating to Greenwich mean time for the five international quiet days. As usual, there is a list of disturbed days on the scale 1 to 4 (highest disturbance). 1912 was exceptionally quiet, only one day reaching standard 2, and none standards 3 and 4. An interesting but somewhat disquieting statement is that, owing mainly to error respecting the "distribution constant" for the deflecting and deflected magnets, a correction of 10 per cent. is required to the previously accepted scale values for the Eschenhagen vertical force magnetograph. Of the field observations, perhaps the most interesting are from a number of closely adjacent stations in two disturbed areas, one the crater of Kilauea, in Hawaii, the other near Wilmington, in Delaware. Large variations

were observed in each case, especially in declination. The Survey, it seems, has decided that, beginning with 1913, all the results of magnetic observations will be referred to the "International Standard of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington." This entails a reduction of one-tenth per cent. in the values of horizontal force previously published. An interesting question of the near future promises to be what this "international standard" really means, and how it is to be maintained constant.

In view of the recent report to the Board of Agriculture on the possibility of reviving the flax industry in Great Britain, a paper on the field and industrial retting of the fibre read before the Société d'Encouragement de l'Industrie Nationale (*Bulletin*, vol. cxxi., p. 153) by M. Albert Durand, the general secretary of the Comité Linier of France, has especial interest. An account is given in this paper of the different methods of retting of flax now used in France, as well as of the new mechanical and biochemical processes which have been the subject of trials on the large scale. It is interesting to note that M. Durand considers the policy of inaugurating central retting establishments, which was proposed in the report to the Development Commission, as one that could be adopted with advantage in France. The account given of the recent processes of Feuillette and Peufaillet for retting flax, illustrated as it is by numerous photographs, is a special feature of the paper.

Science Progress for January contains a vigorous editorial article on militarism and party politics, a criticism by Dr. H. G. Plimmer of Mr. T. A Cook's recent work on the "Curves of Life," and a survey of the problem of vitalism by Mr. Hugh Elliot. Mr. Rhys Jenkins contributes an interesting article on the international struggle for manufactures as illustrated by the history of the alum trade, Mr. Allan Ferguson gives a summary of recent work on capillary constants and their measurement, and Dr. J. N. Pring reviews the question of the formation of ozone in the upper atmosphere and its influence on the optical properties of the sky. Dr. Edridge-Green deals with colour vision and colour vision theories, a subject which at the present time "is in a state of chaos," and Mr. C. E. Wallis gives an interesting comparison of ancient and modern dentistry.

Engineering for January 15 contains an article on the balancing of high-speed machinery by Messrs. H. D. Wheeler and R. V. Southwell. After giving a clear account of the nature of the problem, the authors describe their optical arrangement in use at Messrs. Lawrence Scott and Company's works for the accurate balancing of high-speed armatures. The armature is supported in ball bearings which can move in a horizontal direction at right angles to the shaft against the action of springs which normally keep the bearings central. The armature is driven by a narrow strap which runs vertically on to and off the armature. At a certain speed depending on the size of the armature and the strength of the springs, the two bearings begin to oscillate in the same direction, showing that one side is heavier than the other. At a higher speed generally about double the former, the bearings again oscillate but now in opposite directions, showing a want of dynamic balance. By means of a circular disc with an involute slot in it, fixed on one end of the shaft, light from the vertical filament of a lamp placed under the bearing is focussed on a screen after reflection at a small mirror which rocks about a vertical axis as the bearings move. By means of the curve traced by the spot of light the proper positions of the balance weights can be found more quickly and more accurately than by the "chalk mark" method.

OUR ASTRONOMICAL COLUMN.

The Red Region in the Spectra of Wolf-Rayet Stars.—In the *Comptes rendus* for January 25 (vol. clx., p. 124) a note is presented by M. J. Bosler on an investigation which he has carried out at the Meudon Observatory on the study of the red region of the spectra of Wolf-Rayet stars. The advance in the magnitude and efficiency of astronomical equipment renders a more minute study of the spectra of faint stars possible, and the bathing of photographic plates opens up new regions of the spectrum for close inspection. M. Bosler describes here the result of the work on fifteen Wolf-Rayet stars, seventy-five clichés in all having been obtained with exposures varying from two to three and a half hours. In the communication he gives a short table, reproduced below, showing the wave-lengths and intensities of several of the lines in the spectra of these stars, which he considers are of more special interest. In the brief discussion he refers to the spectra of novæ and their points of semblance with these bright-line stars, and is led to the view that the Wolf-Rayet stars are only the enfeebled remains of novæ which have appeared in the course of past centuries. The following table embodies the data in five of the stars mentioned above, the figures in brackets indicating the intensities of the lines :—

B.D. 3821+39°	Mag. 7·1 (7 plates):	711 (3) 691 (2) 6675 (2) 6563 (5Hα) 643 (2) 6395 (2) 624 (1).
B.D. 4001 +35°	Mag. 8·5 (6 plates):	711 (2) 691 (2) 677 (2) 6678 (3) 6563 (5Hα) 643 (1) 6395 (1).
B.D. 4013+35°	Mag. 8·0 (8 plates):	6718 (3) 664 (?) 657 (5Hα) 6425 (2) 6300 (1) 624 (?).
B.D. 3639+30°	Mag. 9·5 (8 plates):	6717 (2) 6570 (20Hα) 630 (?).
B.D. 3571+43°	Mag. 7·5 (1 plate):	6715 (1) 6563 (5Hα) 642 (2).

Aid to Astronomical Research.—In a communication to *Science* (vol. xli., No. 1046, January 15, 1915) Prof. E. C. Pickering directs attention to the great success of research funds, and points out the large returns which can be obtained from relatively small grants to suitable persons. Believing that the greatest return in astronomical output can be obtained by moderate grants to leading astronomers, he has addressed a letter to twelve American astronomers asking them to make a statement showing how they would apply a grant supposing it consisted of one thousand dollars a year for five years. In the communication in question Prof. Pickering publishes the replies he has received, and all without exception would welcome such a grant. An unexpected result of the request was that in nearly every case the principal need proved to be for assistants. The question now arises whether the money can be obtained, but if all cannot be secured, Prof. Pickering suggests that astronomers with fewer assistants should receive precedence. In some cases it is hoped that those interested in a particular observatory may be willing to supply its needs.

THE SPECTRUM OF LIGHTNING.—It is not very often that a very successful photograph of the spectrum of lightning is obtained, but that secured by Mr. A. Steadworthy, and reproduced in the Journal of the Royal Astronomical Society of Canada (September–October, 1914) is of this nature. The easiest way to secure such photographs is by placing a prism or a transparent replica grating in front of the camera lens. In the case of the former the spectrum only is photographed, but in that of the latter images of both the flash and the spectrum are recorded side by side. Mr. Steadworthy employed the first method, using a 60° dense flint glass prism in front of a 2-in. lens of 16-in. focus. The account is accompanied by the measurements of the lines of the spectrum made by Mr. J. B. Cannon, of the Ottawa Dominion Observatory. The wave-lengths of fifty lines are given, and a comparison table is given containing the wave-lengths of the lines measured in the fine spectrum obtained and described by Mr. Fox in the *Astrophysical Journal* (vol. xviii., p. 295). Mr. Steadworthy also secured ten excellent stereoscopic photographs of lightning flashes, some of which are reproduced in his article.

REPORT OF THE SMITHSONIAN ASTROPHYSICAL OBSERVATORY.—The director of the Astrophysical Observatory of the Smithsonian Institution, Prof. C. G. Abbot, has issued his report for the year ending June, 1914. This report contains a brief statement of the equipment of the observatory, the work of the observatory at Washington, and at Mount Wilson. It is shown that progress has been made in the measurement of the effects produced by atmospheric water vapour on solar and terrestrial radiation. New apparatus for measuring sky radiation has been devised and perfected. A most interesting account is given, including an illustration, of special pyrheliometers for recording solar radiation at great altitudes when attached to free balloons. The highest elevation at which a radiation record has been obtained was about 14,000 metres, or nearly 45,000 ft. The results obtained tend to confirm the adopted value of the solar constant of radiation. A Tower telescope has been erected and put into operation on Mount Wilson. The tower is 50 ft. high and equipped temporarily with a reflecting telescope of 12-in. aperture and 75 ft. focal length. By means of it the variability of the sun has been independently confirmed, and it is stated that changes of the distribution of radiation over the sun's disc occur in correlation with the changes of the sun's total radiation.

ORNITHOLOGICAL NOTES.

IN the report of the council of the Royal Society for the Protection of Birds, embodied in the winter number of *Bird Notes and News*, it is stated that four British lighthouses have now been fitted with bird-perches. The same issue also contains the results of the 1914 competitions for school challenge shields in connection with "bird-and-tree day." Despite a good series of essays from Woburn, the Bedfordshire shield has been withdrawn, on account of the lack of competitors; Lancashire, on the other hand, bids fair to receive the award of a shield during the current year.

In an article on the probable effect of the war in the western area on birds, in *La Nature* for January 16, Dr. E. L. Trouessart expresses the opinion that storks in Alsace and local ground-birds and partial migrants throughout the area of conflict will be the main sufferers. Night-flying migrants, on the other hand, will probably steer clear of the chief areas of conflict, which, looking at the subject in a wide sense, are relatively small. In the neighbourhood of Arras the country was reported to be the resort of myriads of crows in December, attracted doubtless by the rich supply of food.

Among the more notable birds observed in Hertfordshire in 1913, Mr. W. Bickerton records, in the Transactions of the Hertfordshire Natural History Society for January, quail, snipe, and goldcrests as breeding in the county, together with casual visits of the oriole, hobby, and dotterel.

In anticipation of a fuller notice in a forthcoming issue of his *Birds of Australia*, Mr. G. M. Mathews revises the classification of the frigate-birds in vol. ii., No. 6, of the *Austral Avian Record*. Hitherto only two species of these birds have been recognised, *Fregata aquila* and *F. ariel*, the former a widely spread type, split up by some ornithologists into three or four local forms. Mr. Mathews, on the other hand, restricts *F. aquila* to the Ascension Island bird, both sexes of which are wholly black, with no rust-colour on the white heads of the young. The other frigate-birds hitherto classed with *F. aquila* are for the most part identified with *F. minor*, of Gmelin, the typical locality of which is taken to be Jamaica, several subspecies, from the Seychelles, Aldabra, Laysan, the Galapagos, etc., being recognised. The frigate-bird of Christmas Island, Indian Ocean, is described as a new species, with the name of *F. andrewsi*, and is characterised by the under-parts being wholly white in the female and partially so in the male. Lastly, we have *F. ariel*, typically from Torres Strait, characterised by the presence of a white patch on the flanks of the cock, and of which three local races are recognised.

Hybridism in cockatoos forms the subject of an article (illustrated by a coloured plate) by Dr. E. Warren in vol. iii., pt. 1, of the Annals of the Natal Museum, dated September, 1914. A male of the sulphur-crested *Cacatua galerita*, and a female of the slender-beaked *Licmetis nasica*, have been kept for the last eight years or so in a state of semi-confinement in the open air at Pietermaritzburg. During the latter portion of that period the female laid several eggs, two of which were duly hatched. The two hybrids, which are practically similar to one another, are to a great extent intermediate in coloration and plumage between their parents, although nearer to the sulphur-crest than to the slender-beaked species, the resemblance to the former being especially shown by the stoutness and blackness of the beak, as well as by the red loreal patch of the female parent being replaced by orange, and by the total disappearance of the red at the bases of the feathers behind the eyes, so characteristic of the latter. Whether this resemblance of the hybrids to their male parent is due to prepotency in the latter, and the bearing of the whole case on Mendelism, form the subject of a long discussion by the author.

In reference to a recent discussion with regard to birds travelling northwards in autumn on the British coasts, Mr. J. H. Gurney records in the *Zoologist* for December, 1914, that an immense series of flocks of various species were seen flying northwards on October 7 over Cromer, Northreps, and Overstrand, the wind at the time being north. Mr. Gurney is of opinion that such movements are annual, and that after a short interval the wanderers would return south.

During a trip to eastern Siberia in the summer of 1914 Miss Maud Haviland was fortunate enough to come across the curlew-sandpiper breeding at Golchica, at the mouth of the Yenisei. Eggs of this species, it may be recalled, were collected by Mr. H. L. Popham, in July, 1897, on the Kristovski Islands, which are a considerable distance further down the estuary.

According to a narrative published in the January number of *British Birds*, Miss Haviland found the species comparatively abundant in the Golchica district, and procured several skins, as well as a clutch of eggs and a couple of young birds. The last are very similar to young dunlin, but even when a few days old may be distinguished by the shape of the beak. As soon as hatched they leave the dry upland slopes for the sphagnum-bogs that occupy the hollows in the tundra.

R. L.

CLAY AND POTTERY INDUSTRIES.[1]

IN an interesting and valuable introduction, Mr. Graham Balfour, who has been for so many years closely associated with educational work in North Staffordshire, says:—"This volume of collected papers is the first fruits of the Stoke-on-Trent Pottery School, and will in due course . . . be followed by many successors of equal size and value."

The publication of this record of work done by the students and members of the staff coincides with the opening of the New Central Schools of Science and Technology at Stoke-on-Trent, which contain finely equipped chemical, physical, and pottery laboratories and class rooms, and in which the old pottery school finds at last a suitable home.

The school has been conducted by Dr. Mellor for some ten years under conditions which would certainly have damped the ardour of any ordinary man, but this record of work accomplished during these years by Dr. Mellor and his students is a striking testimony to the enthusiasm and ability with which the work has been carried on. It is no longer necessary or desirable that an English pottery student should go to Charlottenburg for his training as a ceramic chemist, for here at hand he has a splendidly equipped school, which has already built up a tradition for research work of the highest importance. The subjects dealt with cover a very large field, but nearly all are of direct practical value to the potter.

Paper xxix. on studies on cylinder grinding is a most excellent contribution, and is a typical example of the thoroughness with which the subjects are treated in their theoretical and practical aspects.

Paper xxiv., on the absorption and dissolution of gases by silicates, by Mr. Bernard Moore and Dr. Mellor, is an extremely interesting and important paper of direct practical value, and the publication of this and other similar work has already beneficially affected pottery practice in this country.

The papers on the nomenclature of silicates and on the chemical constitution of the kaolinite molecule are in another category, but although they are not of direct practical application, they are of great interest to the ceramic chemist, and they show that the outlook of the school is comprehensive and that the work done has an importance beyond the confines of the pottery industry.

The illustrations and descriptions of apparatus—much of which is here described for the first time—are excellent, and it need scarcely be said that Dr. Mellor has used his mathematical ingenuity to advantage in working out and in explaining the problems dealt with. The references to original papers and other published work of German, French, American, and English chemists is a very useful feature of the book.

The papers are naturally of very different values, and their publication in one volume produces a rather uneven "Mosaic" effect, but the impression one gathers from a perusal of the book is the wide scope and thoroughness of the work and its practical value. It is a unique publication in this country as a record of work done by so small a school and in so modest a way.

JOSEPH BURTON.

[1] "Clay and Pottery Industries." Being vol. i. of the Collected Papers from the County Pottery Laboratory, Staffordshire. By several Authors. Edited by Dr. J. W. Mellor. Pp. xvii+411. (London: C. Griffin and Co., Ltd., 1914.) Price 15s. net.

THE IRISH TECHNICAL INSTRUCTION ASSOCIATION.

THE proceedings of the Annual Congress of the above Association, held at Killarney in May last, are of more than usual interest. The operations of the association cover virtually the whole of Ireland, and the congress just held is the thirteenth since the Act of 1902. Without any question these congresses have contributed largely to the development of scientific and technical instruction in Ireland, and incidentally to a keener interest in a more efficient elementary and intermediate education.

The subjects dealt with have been concerned mainly with industrial progress and with the conditions and problems which await investigation and solution in order to ensure a stable advance in the agricultural, industrial, and commercial well-being of the nation.

In this endeavour there is the closest co-operation on the part of the Government and other official authorities with the education committees of the various areas, and four of the papers of high importance, dealing with the "Problem of Small Industries," "The Technical Training of Skilled and Unskilled Workers in France and Germany," "An Industrial Survey of Ireland," and "Technical Instruction for Small Holders," were read by officials of the Department of Agriculture and Technical Instruction, and Mr. T. P. Gill, the secretary of the Department, gave an inspiriting review of the progress of technical instruction in Ireland since its initiation in 1902.

The position and future of the Irish woollen trade was the subject of a highly interesting paper by Mr. J. F. Crowley, of Siemens Bros., Ltd., with the object of showing that the industry, now somewhat languishing, is peculiarly suited to the genius, temperament, and circumstances of the Irish people, and that, given the organisation, both industrial and commercial, due technical training and capital, there is no reason why the industry should not take a high place amongst the productive enterprises of Ireland. It is essential to its success that there should be, amongst other measures, a central woollen textile school established in the south of Ireland for the efficient training of the various grades of persons engaged in the industry.

The paper by Mr. Macartney-Filgate, well illustrated by maps, diagrams, and lantern slides, setting forth the varied industries and natural resources of Ireland and suggesting lines and methods of scientific development, was of much interest. Whilst the available coal supply is limited, there is water power available, easy of transformation into electrical energy, to the extent of $1\frac{1}{2}$ million horse power, together with an almost unlimited supply of peat fuel, and examples were given showing how this and the former source of power had been successfully utilised on a large scale, and only needed capital and enterprise still further to develop it. The extraction of oil from shale on a considerable scale has also been successfully begun, rendering it possible to utilise the internal combustion engine for the service of the small manufacturer. Much valuable information was given by Mr. L. J. Humphreys on the efficiency of co-operative effort in his paper on "Technical Instruction for Small

Holders," illustrated by successful experiments on farms of large extent in Essex and Kent.

The deliberations of the congress reveal the necessity of greater efficiency in the sphere of elementary education, so as to ensure the attendance of all children at school until fourteen years of age and of part time education until at least the age of seventeen.

J. H. REYNOLDS.

FORTHCOMING BOOKS OF SCIENCE.

ANTHROPOLOGY AND ARCHÆOLOGY.

Cassell and Co., Ltd.—Woman's Mysteries of a Primitive People, D. A. Talbot, illustrated. *Macmillan and Co., Ltd.*—General Index to "The Golden Bough: A Study in Magic and Religion," Sir J. G. Frazer; Ancient Hunters and their Modern Representatives, Prof. W. J. Sollas, second edition, illustrated.

BIOLOGY.

Félix Alcan (Paris).—Evolution des Plantes, N. Bernard; Théorie de la Contre-Evolution, Dr. Larger. *A. and C. Black.*—The Story of Plant Life, Rev. C. A. Hall, illustrated; Visual Botany, A. Nightingale, illustrated. *Cassell and Co., Ltd.*—Wonders of Wild Nature, R. Kearton, illustrated; The Book of Hardy Flowers, H. H. Thomas, illustrated. *Chapman and Hall, Ltd.*—Elements of Forestry, Profs. F. F. Moon and N. C. Brown, illustrated. *J. and A. Churchill.*—Plant Life in the British Isles, A. R. Horwood, vol. iii., completing the work, illustrated. *Duckworth and Co.*—A Glossary of Botanic Terms, B. Daydon Jackson, new edition; Birds and Man, W. H. Hudson, new and enlarged edition. *Hutchinson and Co.*—Insect Artisans and their Work, E. Step, illustrated. *Charles H. Kelly.*—Woodland Trees and How to Identify Them, J. H. Crabtree, illustrated. *Longmans and Co.*—British Birds, written and illustrated by A. Thorburn, in four volumes (vols. i. and ii.); Wild Animals of the Empire, E. H. Fisher (pictures in colours). *Methuen and Co., Ltd.*—Diversions of a Naturalist, Sir E. Ray Lankester, illustrated. *John Murray.*—Life-Histories of African Game Animals, T. Roosevelt and E. Heller, two vols., illustrated. *L. Reeve and Co., Ltd.*—The Potamogetons (Pond Weeds) of the British Isles, with Descriptions of all the Species Varieties, and Hybrids, by A. Fryer, illustrated by R. Morgan, continued from Mr. Fryer's Notes by A. H. Evans, and concluded by A. Bennett. *George Routledge and Sons, Ltd., and Kegan Paul and Co., Ltd.*—My Week-end Garden, E. L. Fox, illustrated. *Smith, Elder and Co.—The Minor Horrors of War,* Dr. A. E. Shipley, illustrated (dealing with various insect and other pests which cause disgust, discomfort, and often disease amongst our troops now fighting in all quarters of the globe). *The University Tutorial Press, Ltd.*—Junior Botany, Prof. F. Cavers. *T. Fisher Unwin.*—Chinese Forest Trees, Norman Shaw.

CHEMISTRY.

Baillière, Tindall and Cox.—Muter's Short Manual of Analytical Chemistry, new edition, illustrated, edited by J. Thomas. The general character and scope of the work remain unaltered; the changes and additions made have mainly been necessitated by alterations in the British Pharmacopœia, 1914. *G. Bell and Sons, Ltd.*—Quantitative Laws in Biological Chemistry, Prof. Svante Arrhenius, with diagrams. *J. and A. Churchill.*—Exposives: Their Manufacture, Properties, Tests, and History, A. Marshall, illustrated. *Constable and Co., Ltd.*—Text-Book of Elementary Chemistry, Dr. F. M. Perkin and E. M. Jaggers, illustrated; Life and Letters of Joseph Black, M.D., Sir W. Ramsay, illustrated; The Hydrogenation of Oils, C. Ellis, illustrated; Industrial Chemistry, A. Rogers and A. B. Aubert, new and revised edition, illustrated. *C. Griffin and Co., Ltd.*—A Text-Book of Inorganic Chemistry (in nine volumes), edited by Dr. J. Newton Friend, vol. ii., The Alkali Metals and their Congeners (Group I.), Dr. A. Jamieson Walker; vol. iii., The Alkaline Earth Metals and their Associates (Group II.), H. V. Briscoe and E. Sinkinson; vol. iv., Aluminium and its Congeners, including the Rare Earth Metals (Group III.), H. F. Little; vol. v., Carbon and its Allies (Group IV.), Dr. R. M. Caven; vol. vi., Nitrogen and its Congeners (Group V.), Drs. J. C. Withers and H. F. V. Little; vol. vii., Sulphur and its Congeners (Group VII.), Dr. D. F. Twiss and A. V. Eldridge; vol. viii., The Halogens and their Allies (Group VII.), Dr. G. Martin and E. A. Dancaster; vol. ix., Iron and the Transitional Elements (Group VIII.), Drs. J. Newton Friend and W. E. S. Turner. *Longmans and Co.*—An Amateur's Introduction to Crystallography (from Morphological Observations), Sir W. P. Beale. *Macmillan and Co., Ltd.*—Chemical Technology and Analysis of Oils, Fats, and Waxes, Dr. J. Lewkowitsch, vol. iii., fifth edition, entirely rewritten and enlarged, edited by G. H. Warburton, illustrated. *Methuen and Co., Ltd.*—Practical Physical Chemistry, J. B. Firth. *Williams and Norgate.*—Food Industries: an Elementary Text-Book on the Production and Manufacture of Staple Foods, Dr. H. T. Vulte and S. B. Vanderbilt; Examination of Lubricating Oils, Dr. T. Stillman; A Popular Treatise on the Colloids in Industrial Art, Prof. K. Arndt.

ENGINEERING.

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THE BRONZE-AGE INVADERS OF BRITAIN.[1]

SOMEWHERE about the year 2000 B.C., when the peoples of Western Europe were beginning to learn the uses of bronze and to alter the style of their pottery, a race of invaders began to reach our shores who were totally different from any race which had lived in Britain before that time. The ancient British, although of various strains, were all of them of the long-headed type; they had projecting occiputs; their heads appeared as if compressed from side to side. But those Bronze age invaders had rounded heads, with flat occiputs; their heads had the appearance of having been compressed from back to front. European anthropologists name this round-head type of man "Celtic"; they regard him as an offshoot from the racial type which now attains its greatest purity in the mountainous countries of Central Europe—the "Alpine" type of race. We may take the Bavarian or Savoyard as good modern representatives of the ancient Celtic or Alpine type. They are usually men of short stature, with dark hair and skins, with short and wide faces, regularly modelled features, and rounded heads. The men who invaded England early in the Bronze age and buried their dead in round barrows, were of a different build of body; they were strong, tall, and muscular; they had long faces, rugged features, prominent noses, overhanging eyebrow ridges; we have reason to believe they were fair in hair and complexion. Although these early invaders of Britain had the "Alpine" form of head, it is not among the modern inhabitants of Savoy or of Bavaria that we can hope to find their ancestral stock. We are all agreed that they were continental in origin. Those who have studied our Bronze-age invaders—who have investigated their physical characters, their methods of burial, their domestic animals, their pottery, their weapons and ornaments, are almost unanimously of opinion that we must seek their ancestral home somewhere in that part of Europe which now lies within the bounds of the German Empire. Every year our knowledge of Europe during pre-Roman times becomes more exact, and I propose, once again, in the light of more recent discoveries, and particularly from the point of view of one who is a student of the human body, to seek for the origin of our round-headed ancestry. We shall find that this early invasion of England was but a side eddy of a racial movement which affected almost the whole population of Europe.

How far the British people were exterminated and replaced during the invasions which took place after Roman domination had come to an end is not easily decided. If the Anglo-Saxons brought a new tongue to England they brought no new physical type; in stature and in head form we cannot distinguish them with certainty from the Britons of the period of Roman occupation, nor from the older pre-Roman population. But in this earlier invasion, which began 2000 years before the Roman legions crossed the Straits of Dover, we have not the same difficulty; so distinctive is the head-form of the Bronze-age or "round-barrow" men that we recognise the type at a glance; the type was then new to England. Along all the counties on our eastern seaboard, from Caithness in the north to Dorset in the south, we have found the graves of this distinctive round-headed race. The Hon. John Abercromby, who is our leading authority on British pottery, weapons, and ornaments of the Bronze age, is of opinion that the round-headed invaders were few in number, and that, after gaining a foothold in Kent, they gradually spread northwards and westwards throughout our country. With that conception I cannot agree. The south-eastern part of England was apparently only one of the landing places; the researches which were carried out by Canon Greenwell and Mr. Mortimer leave us in no doubt as to their arrival in eastern Yorkshire; the round-heads became masters of it. The counties which bound the Firth of Forth formed another centre of the invasion; the round-heads conquered that part of Scotland. For our present purpose their extensive settlement in the lowlands of Aberdeenshire and along the southern shores of the Moray Firth are the most important. In recent years Prof. Reid and Dr. Alex. Low, of the University of Aberdeen, have made us familiar with the Bronze-age men of the north-east of Scotland. These more northern invaders had their own peculiar kind of round-headedness, a kind remarkably flat on the crown—just as they had their own kind of graves, their own kind of pottery and ornaments. Sixty years ago that pioneer of anthropology—Prof. Anders Retzius, of Stockholm—identified a certain physical type in Aberdeenshire as similar to that which he had seen amongst the peoples in some of the Baltic provinces of Russia. The invaders who settled on the shores of the Firth of Forth, in Yorkshire, and in the south-eastern part of England have, like their more northern allies, their own distinctive traits in form of head, and in fashions of weapons and pottery. We find a difficulty in explaining the distribution and characters of the "round-head" invasion, if we suppose, as Mr. Abercromby does, that there was only one point of landing, but all our facts find an easy solution if we suppose that the invasion which occurred in the Bronze age, was similar in character and in extent to that which took place in Anglo-Saxon times.

We must presume, then, that those round-headed people, like the Anglo-Saxons, crossed the North Sea; we must presume further that the "round-heads" were then the dominant power in the North Sea. There are certain considerations which make such a presumption difficult to accept. Then, as now, the Continental shores of the North Sea were inhabited chiefly by long-headed peoples. We do know, however, that before the beginning of the Bronze age the "round-heads" had broken through from the hinterlands of Germany and had reached the coast at various points between Scandinavia in the north and Brittany in the south. It is somewhat difficult to believe that a round-headed people were master mariners; sea-power has usually been the appanage of long-headed nationalities; the Spaniards, the Portuguese, the Dutch, Norwegians, and British were, and are, predominantly long-headed. However that may be, we know the round-heads reached the Orkneys, the Hebrides, and the western shores. They spread across the lowlands of Scotland and crossed over to

[1] Presidential Address delivered to the Royal Anthropological Institute of Great Britain and Ireland, on January 26, by Prof. Arthur Keith, F.R.S.

Ireland, where they formed numerous settlements in the north and east. The late Sir William Wilde believed—sixty years ago—that they were the aboriginal inhabitants of Ireland, but we know now that Ireland had been the scene of many an invasion before the round-heads reached her shores. The invading race spread over the richest parts of England; they reached Wales.

We are not yet in possession of sufficient evidence to determine how far the round-heads replaced the older inhabitants of Britain. There were several parts of England, Wales, Scotland, and Ireland which they failed to penetrate; at least we have not found in these parts their peculiar "round-barrow" graves. But in other parts their influence was pronounced. In the Museum of Comparative Anatomy at Oxford there are seventy skulls of people buried in round barrows during the earlier part of the Bronze age; thirty of them are apparently pure representatives of the round-headed race; among sixty-seven skulls gathered from the older or long barrows there is not a single representative of the round-headed people. Dr. William Wright found that the round-heads formed 29 per cent. of the people buried in the round barrows of Yorkshire. In the Aberdeenshire graves of the Bronze period Prof. Reid observed that eleven out of twelve skulls were of the rounded type. Were we to argue from the people buried in the peculiar graves of the early Bronze period we should infer that the invaders had influenced the British population to a profound degree. We have reason to believe that the people buried in the barrows or in cist-graves represent not the population as a whole but only a class—the richer or governing class. I had occasion recently to examine a hundred skulls from a disused London cemetery—representative of the working population—and found that only three showed clear signs of a Bronze-age ancestry. It is unusual to see a head of this rounded type on a British artisan. It is otherwise in the classes from which we draw our Civil Servants, our squires, and professional men. In a West End club, chiefly recruited from these classes, the Bronze-age type of head can be traced in about 20 per cent, of its members. I have said that the counties round the Firth of Forth were centres of settlement. Sir William Turner found that 25 per cent. of modern skulls from these counties were of the short or rounded type. The population of Kent, which has been the scene of more than one round-headed invasion in pre-Roman times, is eminently short-headed, or brachycephalic.[2]

We may speak with equanimity of an invasion which overwhelmed our country between 3000 and 4000 years ago; it brought in a strain of blood which still exerts its influence on certain classes of our population, and which has given us some of our most eminent men. I will cite only three instances—the first being Charles Darwin—one of the most acute and best balanced intellects ever bred in England. No one who has examined the bust which Woolner modelled from him in life can doubt his Bronze-age ancestry. His resemblance to Tolstoi is more than a superficial one. The second instance I shall cite from Scotland. We know the head-form of King Robert the Bruce, for a cast of his skull was taken before his remains were re-interred in 1819. An examination of that cast shows that Bruce possessed all the essential features of the Bronze-age race. Lastly, I take an instance from Ireland, where there are many descendants of the Bronze-age invaders, selecting that most lovable of men—Oliver Goldsmith. It is also a matter worthy of note that John Bull, as portrayed by "Mr. Punch," carries in his form of head a distinct impression of a Bronze-age ancestry.

So far as concerns the basis of the British population the invasion of the round-heads remained without effect; the mass of the people retained the long-headedness which had characterised their ancestors in the Neolithic and later Palæolithic ages. When we turn to France and mark the changes which occurred in her population at a corresponding period, we find the end result was totally different, there was a complete revolution in head-form; from being a long-headed people the majority of the French became round-headed. Long before the end of the Glacial period we find long-headed races in possession in France; even when the Glacial or Pleistocene period had ended and the Neolithic age was well begun, the native tribes of France retained the more ancient type of head. But even in the older or Pleistocene period we find some trace of the short-headed race. The skull found at Chancelade, in the Dordogne, in circumstances which convince us that its owner must have lived in one of the later phases of the Glacial or Pleistocene period, possesses certain definite features in its hinder or occipital region, which show affinity to the round-headed type. In the more superficial strata of a gravel pit at Grenelle, a suburb of Paris, a series of skulls have been found[3] which show all the features of our invaders of the Bronze age. In deeper and more ancient strata all the skulls were of the long type. There is good reason for believing that the Grenelle skulls, from both the deeper and more superficial strata, are of Pleistocene age.

Apparently then the round-head invasion of France had begun at a much earlier date than in England. M. Salmon collected measurements of the skulls of 688 people who lived in France during the Neolithic period—or, to make my meaning more clear, in a pre-Bronze age—and found that 58 per cent. were long-headed, 21 per cent. round-headed, the rest (21 per cent.) forming an intermediate group. A late Neolithic sepulchre in the Marne, (Petit Morin) yielded a higher percentage of short-heads, viz., 27 per cent., while the long-headed group had become much reduced —34 per cent.

We see then that the round-headed invasion of France took place at a much earlier date than that of Britain. The French invaders, appear to have belonged to a different branch of the round-headed stock. It is true that north of the Seine one frequently sees amongst the skulls of Neolithic France the identical type which invaded Britain; we note the same strong and rugged faces, the same prominent supra-orbital ridges and the same flattened occiputs which characterise our British invaders. We suppose these northern forms must have come, like our ancestors, from across the Rhine. But the majority of the round-heads which then invaded France were of a different type; their foreheads were full and wide and destitute of great brow ridges; their faces were short and wide and of a less massive cast; their occiputs were rounded rather than flattened. They represent exactly what modern anthropologists have in mind when they speak of the "Alpine" race or type. The type deserves that name, for it evidently issued from the western flanks of the Alps and spread gradually over the whole of France. The revolution in head-form never passed beyond the Pyrenees. Long before the arrival of Cæsar in Gaul, the majority of the French people had become of the round-headed type. From Cæsar's time onwards the people who lived between the Loire and the Seine have been regarded as the representative of the true Celtic race. Our

[2] See paper on Hythe Crania by Prof. F. G. Parson, Journ. Roy. Anthrop. Instit., 1908, vol. xxxviii, p. 413.

[3] See "Crania Ethnica," Quatrefages and Hamy, 1882.

Celtic-speaking people—the British "Celtic fringe"—belongs to a very different European stock.

The anthropological history of Italy is not unlike that of France. Very few remains of the people who lived in Italy before the dawn of the Neolithic period are known, but such as have been found lead us to believe that the early inhabitants were long-headed and apparently members of the dark-haired stock which inhabited the lands surrounding the Mediterranean—members of Prof. Sergi's "Mediterranean Race." Italy, like France, was apparently invaded from the flanks and passes of the Alps. In some of the graves of Lombardy, belonging to a later phase of the Neolithic period, we find skulls of a short-headed people. Some of these have the massive faces, the great supra-orbital ridges and the peculiar occipital flattening which characterise the Bronze-age invaders of Britain—but others, apparently the more numerous—are of the true Alpine type, the type which has left its influence on France. Long before the Etruscans and Romans had risen into prominence, the round-heads had permeated the northern half of Italy. I have lately examined the collection of crania which Dr. Niccolucci gathered from ancient Etruscan and Roman tombs—they are preserved in the Museum of the Royal College of Surgeons; fully a fifth of them manifest distinct traces of a round-headed ancestry. Collections of modern Italian crania show that the population has become increasingly brachycephalic since Roman times. In that Italy does not stand alone; it has been so with the population of France, Germany, Russia, Austria, and Greece. The anthropological surveys which have been carried out by Dr. Ridolfo Livi on army recruits drawn from all parts of Italy prove that in the southern half of the country the long-headed, dark-haired Mediterranean race is still the dominant population. But northern Italy is eminently round-headed.

It is generally agreed that the ancient Greeks were long-headed, and were members of the Mediterranean race, but apparently before they reached the heyday of their civilisation and of their power, a wave of round-heads had already penetrated the Balkan peninsula and reached the shores of the Mediterranean. The vast majority of the peoples inhabiting the Balkan Peninsula and the Austrian Empire manifest a high degree of brachycephaly. It was not always so along the valley and across the plains of the Danube. For instance, Prof. Toldt, of Vienna, did not find a single round-head in a collection of skulls gathered from ancient graves in upper Austria; 80 per cent. of the modern population is round-headed. So far as we can yet judge, the Danube Valley, in its width and length, was inhabited by a long-headed population in the Neolithic period. There is, however, an exception—the skull discovered fully thirty years ago by Prof. von Luschan at Nagy-sap, in Hungary, deeply embedded in the loess of the Danube, and presumably pre-Neolithic in date. Apparently before the Neolithic period had ended the round-heads of the true Alpine type began to penetrate the modern bounds of the Austrian Empire. The inrush of German-speaking peoples in post-Roman times did not stay the growing dominancy of the round-heads. Prof. Matiegka, of Prague, found that the remains of people buried in Bohemia during the ninth century A.D. yielded 14 per cent. of brachycephalic skulls, those of the sixteenth century yielded 70 per cent.; modern graves 85 per cent. The diverse peoples of the Austrian Empire—they are really more differentiated in speech than in racial type—have thus become dominated by a round-headed stock in comparatively recent times.

North of the Carpathians the story is the same. On the plains of Russia there are numerous mounds or tumuli—"kurgans"—containing the remains of ancient Russians. Seventy years ago Russian anthropologists began to investigate these mounds; they found from their contents that some of them dated back to the Neolithic period, others were of the Bronze age. They found, too, that the people buried in the older mounds were of the long-headed type—not unlike the men whose remains lie in our long barrows. The best modern representatives of this type are the inhabitants of Scandinavia—I shall speak of this form as the Scandinavian type. I have examined lately a series of accurate casts—forty in number—made from skulls found in these ancient Russian mounds. Twenty-seven of these are of the Scandinavian type; only eight of them are round-headed. Of these eight, five show the features of our invaders of the Bronze age—the massive face, the strongly marked supra-orbital ridges, the flattened occiput. The remaining three are more of the Alpine type. The vast majority of the people within the bounds of European Russia are now brachycephalic; only in those Baltic provinces which lie to the south of the Gulf of Finland has the ancient Scandinavian type succeeded in surviving. In Finland, itself, the Scandinavian type has been replaced by the modern brachycephalic Finn. So far as we have gone the western parts of Russia afford the most probable cradle for the British invaders of the Bronze period.

The anthropological history of Germany is very similar to that of western Russia. To the eye of the anthropologist the modern German Empire falls into three very distinct, but very unequal parts. There is, in the first place, the western or coastal area—embracing Oldenburg, Holstein, Hanover, and parts of Westphalia, where the Scandinavian or Anglo-Saxon form of head is still the dominant type. From the evidence afforded by ancient graves, we have no doubt that the coastal or western German does represent the Neolithic population of Germany, and he does not differ materially from the ancient long-headed native of western Russia. Then there is the second or southern area, including Bavaria, Wurtemberg, Baden, and the upper areas of the Rhine Valley. The modern population of these lands is eminently brachycephalic. Anthropologists are agreed in regarding them as typical representatives of the Alpine race. When and how the change in head-form was effected in South Germany we do not know definitely, but ancient graves, even down to the time of the disruption of the Roman Empire, yield skulls of the long or Scandinavian type. Bavaria, Wurtemberg, and Baden have undergone a revolution in head-form, not unlike that which has overtaken the Austrian Empire and France. In all of them the primitive population has become "Alpinised." In the remaining part of the German Empire—the part which may be described as Prussian, and which contains at least two-thirds of the total population of the Empire—a transformation in head-form has occurred, very similar to that which has overtaken the earlier inhabitants of Russia. German anthropologists have made no attempt to estimate the extent to which the modern Prussian population has assumed the Russian or Slav form of head, nor has any special endeavour been made to ascertain when the change took place. Prof. Welcker of Halle, found that out of a small collection of thirty German skulls eighteen were brachycephalic. In an ancient Prussian cemetery which had been used between the ninth and twelfth centuries, 30 per cent. of the skulls were of the long type and 18 per cent. of the round. Four centuries ago Vesalius regarded flatten-

ing of the occiput—such as frequently occurs in our Bronze-age invaders—as a characteristic feature of the German head.

We look in vain for the ancestors of our Bronze-age invaders among the modern peoples who live along the German or Dutch shores of the North Sea. When, however, we turn to the investigations carried out by Danish anthropolgists during the last seventy-five years we find a key to our problem. The classical researches of Nilsson brought to light in the Neolithic graves of Denmark a people with exactly the same rounded form of head as that of our British invaders. It was at first believed that these round-heads were the original inhabitants of Denmark, but later discoveries showed that the long-headed race of the long-barrow or Scandinavian type—which also occurred in Neolithic graves—was the older form. Our Bronze-age ancestors had reached the Danish peninsula in the Neolithic period. Recently Prof. Nielsen has published a very instructive table, showing how the head-form has altered at various periods in Denmark. His table is as follows:—

	Dolicho-cephalic	Meso-cephalic	Brachy-cepalic
Neolithic period ...	30 ...	44 ...	26
Early Iron period ...	60 ...	29 ...	3
Modern	12 ...	55 ...	33

The table shows that after the Neolithic invasion round-heads became almost as common as long-heads in Denmark. It will be remembered that the round-barrows have revealed a similar proportion in England. A further parallel between Denmark and England is seen in the fate of the round-heads. By pre-Roman times the long-head had again asserted its dominance in both countries; in Denmark the round-heads form only 3 per cent. of the pre-Roman grave skulls. But after the Roman period the histories of the two countries diverge; the high proportion of long-heads disappeared from the Danish population, so that now they form only about 12 per cent. There can be little doubt as to the cause of the recrudescence of round-heads in Denmark. Her land-frontier is open to Germany and her population has undergone a change in head-form similar to that which has overtaken the people of Prussian Germany in post-Roman times.

In Denmark, then, we may recognise two invading waves of round-heads; but it is the oldest—the Neolithic wave—containing men marked by all the physical characters which we recognise in the English round-barrow men which interests us here. That was the first wave of round-heads to break through the long-headed population in Western Europe and reach the shores of the North Sea. Before the next wave broke, the Danes had apparently become again a long-headed people. Denmark was not the only country to suffer from the first invasion. Our "round-barrow" race had formed the settlements in the south of Sweden and on the south-western coasts of Norway. Even now, as in parts of England, the descendants of that early invasion can be traced in the lands in which the round-heads settled. The round-heads also reached the lands at the mouths of the Elbe, Wesser, and Ems. Oldenburg, between the estuaries of the Wesser and the Ems, has yielded Neolithic graves. Out of four skulls from such graves one is similar in form to that of our Bronze-age invaders. Apparently, too, they reached the coast by way of the Rhine. At least the Dutch people living in districts near the mouth of the Rhine show a much higher degree of brachycephaly than their neighbours either to the north or south. We have already traced the entrance of our Bronze-age type into northern France in the Neolithic period. They, too, reached the coast of Normandy.

We have made a tour round Europe in search of the native land of our Bronze-age invaders. We have merely found secondary settlements along the eastern shores of the North Sea and the possible points of their embarkation. Their native land we have not discovered. Our predecessors, when in difficulty over the origin of a European race, fell back on Asia; they had an infallible belief in the racial potentiality of that continent. There is now a distinct change amongst European anthropologists in their attitude towards such problems. They believe that our own continent may have produced its own races. But so far we have searched in vain for the cradle of the European round-headed stock; we have found neither the beginning of the dark-haired true Alpine type nor of the fair-haired northern form from which our round-barrow men sprang. But it is lawful for us to infer that the centre of dispersion is the probable cradle of origin. Now all the evidence at our disposal points to the central mountainous region of Europe as the centre of dispersion. It is therefore in the plains along the northern flanks of the central mountainous region of Europe that we may expect to find the cradle of our round-headed British ancestry.

The conquest of Europe by the "round-heads" is one of the most amazing revelations of prehistoric research. The outlook for the future of the fair-haired, long-headed stock does not, at first sight, seem very promising. Prof. Gustav Retzius, when he delivered the Huxley Lecture before this institute in 1909, gave expression to such a view. "There lie," he said, "in the circumstances to which I have called attention, a very real danger of the north European long-headed race not being able to hold its own. Just as it has been ousted during the past thousand years from Germany and other countries in Central and Eastern Europe by the dark-haired, small-statured round-heads, it will probably have to yield in Britain too, and be reduced in numbers, perhaps by degrees disappear entirely out of the fatherland of their ancestors and of themselves, by reason of the ever-increasing might and power of industrialism with which they seem ill-fitted to cope successfully in the long run. The prospect is depressing, it cannot be denied, but the development of things in the world is not seldom harsh and unmerciful."

Prof. Retzius's statement is that of a man who commands the respect and esteem of all anthropologists; he speaks of the fate of his own—the Scandinavian—racial stock, and is therefore predisposed to take the most hopeful outlook possible. It is beyond denial that in France, Austria, Russia, and in the greater parts of Germany and Italy a round-headed stock has ousted a long-headed one. Scandinavia, England, and Spain have escaped this domination by reason of their comparative isolation. Yet I dare think the future of the big-bodied, fair-haired, long-headed European stock may be more prosperous than Prof. Retzius is inclined to think. In the first place we have clear proof that at one time—some 4000 or 5000 years ago—the round-headed stock did break through and reach the western shores of Europe. It leavened England, but became submerged; it met a similar fate in western Germany and in Holland. In the earlier centuries of the present era the long-heads in north-western Europe must have undergone a recrudescence in numbers and in power. They broke eastwards on the plains of the Vistula and Danube; they imposed their speech on the conquered peoples, but the vanquished imposed on them their features of face, head, and body. They broke westwards into France, and lost both their

tongue and their head-form; they crossed the North Sea and kept both their tongue and their shape of head. Sea power is also a potent factor in anthropology, and so far such power in Europe has been in the hands of long-headed stocks. What the long-head has lost in Europe he has gained in countries which lie beyond the seas, by virtue of his command of the sea. It is too soon to speculate on what the head-form of these new trans-oceanic settlements is to be—but all the signs point rather to a victory of the long-heads.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The following advanced courses of lectures, to which admission is free, are now being delivered:—A course, with practical work, in dynamical meteorology, at the Meteorological Office, South Kensington, S.W., by Dr. W. N. Shaw; a course on the Protozoa, at the Lister Institute of Preventive Medicine, Chelsea, S.W., by Prof. E. A. Minchin; a course on metabolism in infancy, at Guy's Hospital, Borough, S.E., by Dr. M. S. Pembrey and Mr. J. H. Ryffel; a course on certain aspects of British ecology, at University College, Gower Street, W.C. The remaining lectures of the last-named course are by Prof. R. H. Yapp (fen vegetation), Prof. G. S. West (the occurrence and distribution of fresh-water algæ), and Mr. A. D. Cotton (the algal vegetation of the salt-marsh and seashore).

MANCHESTER.—The Council of the University, with the approval of the Board of Agriculture and Fisheries, has appointed Mr. W. Percy Middleton Stock Officer for the counties of Lancashire and Cheshire. Mr. Middleton will be attached to the Department of Agriculture, and will be given an office in the University buildings as well as an office in a central position in each of the two counties.

OXFORD.—The annual report of the Committee for Geography, just published, gives a full account of the work done in the geographical department during the past year. The number of students working at geography was forty-one (twenty-three men and eighteen women). Lectures to the number of 124 were delivered by the professor (Dr. A. J. Herbertson, Wadham College) and his assistants, the subjects including natural regions of the British Empire, economic geography, Central Europe, the geographical distribution of man, climate and vegetation regions, topography of Europe, the Oceans, the British Isles, meteorology, influence of the geography of Greece on its political history, and the art of geographical description. Besides these, special lectures were given by Prof. T. Edgeworth David, Sir Ernest Shackleton, and others. Many field excursions were undertaken, and the report includes a long list of gifts to the library and collections. A successful vacation course was held in August, which was attended by 160 pupils (54 men and 106 women).

SHEFFIELD.—Dr. A. J. Hall has been appointed to the post of lecturer in medicine.

THE Central Committee for National Patriotic Organisations, 62 Charing Cross, W.C., has issued, at the price of 2*d.*, a list of publications bearing on the war. It comprises the titles of works likely to be useful to those persons anxious to understand the immediate causes and remote origins of the war, of volumes dealing with the war itself or with naval and military matters generally, and of pamphlets on these subjects sold at 6*d.* or less. Full particulars are given as to where the volumes may be procured, and the pamphlets may be purchased through the Central Committee.

IT was announced to the students of Stevens Institute of Technology at their annual dinner in the Hotel Astor on January 23 that their ten-day campaign to raise 272,000*l.* had yielded 232,854*l.*, and that an extension of time had been granted in which the remainder might be collected. *Science* says that Dr. A. C. Humphreys, president of the institute, made the confident prediction that the whole amount would be raised by the end of the week. From the same source we learn that the Harvard University corporation has set aside 20,000*l.* to pay Belgian professors who have been driven from their land by the war and may give courses at Harvard University next year. Mr. J. R. Magee has left 4000*l.* and a certain further residuary portion of his estate to Haverford College, to be added to the general endowment fund.

THE Association of Teachers of Domestic Subjects has issued its annual report for 1914. During the year important work was accomplished by the association. Miss Ailsa Yoxall's book on the "History of the Teaching of Domestic Economy" was completed for the association; it was reviewed in the issue of NATURE for November 19 last (vol. xciv., p. 308). A long-considered salary scale received its final form, and suggested a rate of pay which, if adopted by education authorities, would bring domestic subjects teachers into line financially with those of general subjects. We understand the suggested scale is receiving sympathetic consideration by various education authorities. The report contains detailed accounts of the activities of the different branches of the association throughout the country, and these provide satisfactory evidence of a widespread desire to improve the teaching of the important practical subjects with which the members are particularly concerned.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 4.—Sir William Crookes, president, in the chair.—Prof. G. H. **Bryan** and R. **Jones**: Discontinuous fluid motion past a bent plane, with special reference to aeroplane problems. The present investigation is based on the theory of discontinuous fluid motion, and in particular on the recent developments of that subject by Sir G. Greenhill. Its object is to obtain a hydrodynamical estimate of the effects of camber on the lift and drift of a lamina moving through a fluid, the motion being two-dimensional, and regarding the lamina as an aerofoil. Instead of considering continuously curved laminæ, the investigation deals with laminæ the front and rear portions of which are plane, but which meet at a dihedral angle. The method is applicable to surfaces with two or more bends. The general conclusions are in agreement with experimental results, that a moderate degree of camber is beneficial in increasing the lift without a corresponding increase in drift.—Prof. A. **Fowler**: A new type of series in the band spectrum associated with helium. The band spectrum associated with helium, as previously described by Curtis and Goldstein, includes bands with single heads and bands with double heads. A preliminary analysis of this spectrum has led to the following conclusions:—(1) The doublets do not follow the ordinary law of band spectra, but can be arranged in two series of the type hitherto exclusively

associated with line spectra, and can be represented by the usual formulæ involving the Rydberg constant. Nine bands of the main series, and four of the second fainter series, have been identified. (2) The two series may be likened to the principal and diffuse series in the case of line spectra, but the usual relation between such series is not certainly indicated, and no equivalent of the sharp series has yet been traced. (3) The doublet separations are not in accordance with those associated with line spectra; they diminish in passing along the series, but do not vanish at the limit. No regularity in the arrangement of the single bands has been recognised.—T. R. **Merton**: The spectra of ordinary lead and lead of radio-active origin. Wave-length measurements have been made of some of the principal spectrum lines of ordinary lead and the lead in pitchblende residues. It might reasonably be expected that small differences in the wave-lengths would be found, more especially in the case of any lines which belong to doublet or triplet series, since, according to the views of Prof. Hicks, an atomic weight term enters exactly into the separations of such doublets or triplets. No series have yet been discovered in the spectrum of lead, but it is probable that they exist, and an estimate of the order of the differences of wave-length to be expected, according to Prof. Hicks's views, is given. No differences of this order have been observed, the spectra taken in juxtaposition showing no differences of wave-length, whilst the wave-length measurements of seven of the most prominent lines in the two leads agree to 0·03 Å.U. A special comparison of the line $\lambda=4058$ Å.U. with the interferometer shows that the wave-lengths of this line in the ordinary and radio-active lead are identical to within 0·003 Å.U.—A. O. **Rankine**: The viscosity of the vapour of iodine. The paper records the method used by the author for measuring the viscosity of iodine vapour at four different temperatures ranging from 124° C. to 247° C. The basis of the method is the distillation of iodine from one vessel to another through a narrow capillary tube, the temperature of which could be varied. One of the vessels contains solid iodine, and is raised to 100° C., thereby establishing the driving pressure. The other vessel is immersed in a freezing mixture, so that the iodine which is transpired as superheated vapour is condensed there, the mass so transpired being determined by weighing the vessel, which is removable. The method gives, in repeated experiments, very consistent results, and the values obtained may be taken as accurate to about ½ per cent. The range of temperature variation is not large enough to make the results suitable for testing the validity of Sutherland's formula, but it is found that they are, at any rate, not inconsistent with that formula.

Physical Society, January 22.—Sir J. J. Thomson, president, in the chair.—Dr. A. **Russell**: Practical harmonic analysis. Making the assumption that the graph of a periodic function is given, the problem of the best way of determining the Fourier constants in the series equation which represents it is considered. The ordinary method of procedure is to neglect all the harmonics above a certain order and determine the coefficients of the harmonic terms by making the curve represented by this equation pass through a number of arbitrarily selected points on the given curve. This is the method used, for instance, by Runge and Grover. A serious defect in this solution is that the values found for the amplitudes of the harmonics, more especially for the higher harmonics, may be very different from their true Fourier values. The method gives no indication of the magnitude of these errors. Gauss pointed out many years ago that the solution of this limited problem could be written down at once mathematically, and that it was of importance in certain interpolation problems in astronomy. Another method has been suggested recently by Silvanus Thompson. He uses certain series formulæ for finding the Fourier constants. The author suggests other series formulæ of a similar kind, and gives numerical examples to illustrate the accuracy attainable by the use of infinite series formulæ. T. **Smith**: Measuring the focal length of a photographic lens. The focal length of a compound lens is obtained solely by focussing on the camera screen the image of a distant object on the lens axis by the complete lens and by each of its components separately. One additional focussing of the same object when the separation of the components is altered determines the focal lengths of each component. The method is both accurate and quick, and requires only a camera and the lens.

Challenger Society, January 27.—Dr. G. H. Fowler in the chair.—D. J. **Matthews**: Hydrographical observations on the ice patrol *Scotia* in the North Atlantic, 1913. The *Scotia* cruised in the ice-area from April 9 to August 3, 1913, and crossed the Labrador current fourteen times between the latitude of Hamilton Inlet in 54° N., and the southern part of the Newfoundland Banks in 44° N. Observations of salinity and temperature were made down to a depth of 550 fathoms, including seven complete sections across the current. The Labrador current had a temperature generally below 0°, except at the surface, and a salinity of 32·5 to 33·5 per thousand, while the Atlantic water to the eastwards reached 34·5 per thousand or more. The boundary between the two water-masses was marked by the isohaline of 34·00 in the region northward of the Banks; further south the conditions were more confused. The characteristic temperature minimum was found in all water of polar origin except on the Banks, where it was disturbed by the shallows. Measurements of currents and of the drift of bergs were made by means of mark buoys, either anchored to a sinker on the bottom or to a drag working at a depth of 1000 fathoms. The velocities observed were all low, generally less than half a mile an hour, and calculations by Bjerknes's method from differences of density gave similar results. Off Cape Race a slow northerly set was observed instead of one of about one mile per hour to the south and west, as is usually experienced here. On the Banks measurements were made with the Ekman current-meter at depths of five and twenty-five fathoms at two stations; the observations were repeated at frequent intervals during thirteen hours, and showed that the current is almost entirely tidal with a very small easterly resultant. Prof. Barnes's observation that the proximity of an iceberg can be detected by a slight rise in the temperature of the water could not be confirmed, as similar rises were recorded when no ice was near.—C. Tate **Regan**: Colour-changes in a flat-fish, *Platophrys podas*.

Linnean Society, February 4.—Prof. E. B. Poulton, president, in the chair.—Ruth C. **Bamber**: Report on fishes collected by Dr. Crossland from the Sudanese coast of the Red Sea. This collection consists of ninety-one species, of which two are new to science and two others require re-description. Most of the others are typical Red Sea coastal fishes, and were obtained by Dr. Crossland at various localities on the Sudanese coast between Suez and Suakim.—Dr. Marie C. **Stopes**: A fossil of doubtful affinity. The fossil was found *in situ* in the Lower Greensand at Luccomb Chine, in a horizon in which a number of new plants as well as the famous *Bennettites Gib-*

sonianus have been discovered. The specimen in transverse section of an area of 20×35 cm. shows a uniform structure of most beautifully petrified tissue, which appears to be quite unlike any known fossil. Photomicrographs were exhibited showing the details of the tissues, which, in many respects, are like a giant phloem. The name *Vectia luccombensis* is proposed.—Dr. H. **Drinkwater**: Brachydactyly as an example of Mendelian inheritance. Brachydactyly (shortness of fingers and toes) has been studied by Dr. Drinkwater in four distinct families. In affected people, all the fingers and toes are short, and the stature is reduced. The chief defect is an extremely abortive condition of the second phalanx, which becomes ankylosed to the third, in two families. In the other two it is not ankylosed, and the fingers are not so short (Minorbrachydactyly), but the toes are alike in the four families. The epiphyses of the second phalanges are absent in the shortest fingers. The abnormals transmit the abnormality to about half their offspring. The normals never transmit the abnormality: it is bilaterally symmetrical and never skips a generation. It is a Mendelian dominant.

MANCHESTER.

Literary and Philosophical Society, January 12.—Mr. F. Nicholson, president, in the chair.—Prof. W. H. **Lang**: Studies in the morphology of Isoëtes. Part 2, the analysis of the stele of the shoot of *Isoëtes lacustris* in the light of mature structure and apical development. The author gives the results of a re-examination of the stele of *Isoëtes lacustris*, special attention being paid to points disputed or left obscure by previous investigators. From within outwards the following tissues can be distinguished: (1) central column of primary xylem; (2) peripheral zone of xylem, including the bases of the leaf-traces abutting on the central column of xylem; (3) parenchymatous xylem-sheath; (4) primary phloëm, continuous with phloëm of leaf-trace; (5) secondary prismatic tissue; (6) meristem of the anomalous secondary tissue; (7) cortical tissue. In some stems the meristem and the secondary tissue are completely wanting. The procambial tissue immediately behind the growing point gives rise to the central column of primary xylem. The other primary tissues of the stele are differentiated in the inner portion of the radiating rows of procambial cells surrounding the central region; the cortex is derived from the outer portion of this radiating tissue. There is thus a radial seriation of the elements from the outer xylem to the cortex quite independent of any secondary growth. The inner xylem is regarded as centripetal in relation to the poles of the leaf-traces applied to it, these being the only equivalents of protoxylem. The outer xylem lies between and outside the protoxylem poles. It is thus comparable, on the one hand, with the outer primary xylem of the Filicales, and, on the other, corresponds in position to the normal secondary xylem of the Lepidodendreæ. On this view a stele of Isoëtes would contain tissues corresponding to the centripetal primary xylem, the normal secondary xylem, and the anomalous secondary xylem (found in some species) of Lepidodendreæ.

PARIS.

Academy of Sciences, February 1.—M. Ed. Perrier in the chair.—Armand **Gautier**: The soldier's ration in time of war. The work of Atwater on the heat actually evolved in the human body by the constituents of food, proteids, fats, and carbohydrates, is made the basis of the discussion. This is supplemented by data derived from the study of two peasant families carried out over a period of twelve months, of railway workers, and of Belgian agriculturists. The average, in calories, for the daily food ration of workers in the north of Europe is 4349, for the French climate 3947, the difference being partly due to the higher temperature and partly to the higher weight of the inhabitants of northern Europe as compared with the French. The French army ration gives 3190 calories, and the author considers that in cold weather this should be supplemented by at least 900 calories, and argues that a portion of this, at least, should be in the form of wine.—G. **Gouy**: The Brownian movement according to Lucretius. An extract from "De rerum natura," in which the movements of motes in air strongly illuminated is ascribed to the action of the invisible movements of the atoms.—MM. **Brandt** and Darmezin **du Rousset**: A new form of polar extremities for electro-magnets used in surgery. A general description, without details, of flexible poles capable of being used in the extraction of magnetic fragments from wounds.—L. **Gay**: The solubility of hydrates.—José Rodriguez **Mourelo**: The phototropy of inorganic systems. Strontium sulphide. A study of phototropy, or the change of colour under the influence of light and of phosphorescence of strontium sulphide containing various proportions of manganese, or of manganese and bismuth together. The experimental results are given, the theoretical discussion being reserved for a later communication.—Lucien **Lilais**: Waterproofing tissues by impregnation of the constituent elements. Observations on the measurement of the strength of tissues. Instead of waterproofing the woven material, the rubber solution is introduced on the thread during weaving. The method has the advantage of preserving the ordinary appearance of the finished material, and as compared with the ordinary waterproofing process the material is more resistant to wear by friction.—R. **Chudeau**: The geology of the Timbuctoo-Taoudeni-Kidal and Gao regions.—G. **Arnaud**: The suckers of Balladyna, Lembosia, and Paradiopsis.—Maxime **Ménard**: The localisation of projectiles and the examination of the wounded by the X-rays. A discussion of the comparative advantages of the radioscopic and radiographic methods. The former cannot guide the surgeon during the actual operation, may cause grave burns to the operator, and even when carefully conducted may fail to discover certain foreign bodies. A modification of Hirtz's radiographic method is described as advantageous, and details of eight operations chosen from a total of eighty-eight are given.

BOOKS RECEIVED.

Memoirs of the Colombo Museum. Series A. No. 1. Bronzes from Ceylon, chiefly in the Colombo Museum. By Dr. A. K. Coomaraswamy. Pp. 31+xxviii plates. (Colombo, Ceylon: The Museum.)

Notes on Practical Physics for Junior Students. By Prof. C. G. Barkla and Dr. G. A. Carse. Pp. xii+118. (London: Gurney and Jackson.) 3*s.* 6*d.* net.

Manual del Entomologo. By P. L. Navas. Pp. 79. (Barcelona: Tipografia Catolica.)

Dew-Ponds: History, Observation, and Experiment. By E. A. Martin. Pp. 208. (London: T. Werner Laurie, Ltd.) 6*s.* net.

Physical Geography. By P. Lake. Pp. xx+324. (Cambridge University Press.) 7*s.* 6*d.* net.

Sewage Purification and Disposal. By G. B. Kershaw. Pp. x+340. (Cambridge University Press.) 12*s.* net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, September-November, 1914. Edited by R. M. Milne. Pp. 28. (London: Macmillan and Co., Ltd.) 1*s.* net.

Subjects for Mathematical Essays. By Dr. C. Davison. Pp. x+160. (London: Macmillan and Co., Ltd.) 3s. 6d.

Heaton's Annual. The Commercial Handbook of Canada and Boards of Trade Register. Eleventh year. Pp. 514. (Toronto: Heaton's Agency.) 5s.

University Correspondence College. The Calendar 1914–15. Pp. 142. (London: University Tutorial Press, Ltd.) 1s. net.

Junior Algebra. By A. G. Cracknell and A. Barraclough. Pp. vi+280. (London: University Tutorial Press, Ltd.) 2s. 6d.

Marvels of Insect Life. Edited by E. Step. Pp. viii+486. (London: Hutchinson and Co.) 10s. 6d. net.

The Drama of the Year in South Africa. By M. Ritchie. Pp. x+118. (London: T. C. and E. C. Jack.) 2s.

The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 22. Pp. 561. (London: Headley Bros.)

Evolution and Disease. By Dr. J. T. C. Nash. Pp. viii+73. (Bristol: J. Wright and Sons, Ltd.) 3s. 6d. net.

Dynamometers. By Rev. F. J. Jervis-Smith. Edited and amplified by C. V. Boys. Pp. xvi+267. (London: Constable and Co., Ltd.) 14s. net.

Masonry as Applied to Civil Engineering. By F. Noel Taylor. Pp. xi+230. (London: Constable and Co., Ltd.) 6s. net.

Foundations of Plant-Breeding. By Dr. J. M. Coulter. Pp. xiv+347. (New York and Chicago: D. Appleton and Co.) 6s. net.

A Guide to the Fossil Remains of Man in the Department of Geology and Palæontology in the British Museum (Natural History), Cromwell Road, S.W. Pp. 30. (London: British Museum (Natural History). 4d.

University College of North Wales. Calendar for the Session 1914–15. Pp. 404. (Manchester: J. E. Cornish, Ltd.)

Squire's Pocket Companion to the British Pharmacopœia. By P. W. Squire. Second edition. Pp. xvi+1040. (London: J. and A. Churchill.) 10s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—*Lepidostrobus Kentuckiensis*, formerly *Lepidostrobus Fischeri*, Scott and Jeffrey; A Correction: Dr. D. H. Scott.—The Excitatory Process in the Dog's Heart. II.: The Ventricles: T. Lewis and M. A. Rothschild.—The Variation in the Growth of Mammalian Tissue *in vitro* according to the Age of the Animal: A. J. Walton.

ROYAL INSTITUTION, at 3.—Nations as Species: Dr. P. Chalmers Mitchell.

INSTITUTION OF ELECTRICAL ENGINEERS at 8.—Conditions Affecting the Variation in Strength of Wireless Signals: Prof. E. W. Marchant.

CHILD STUDY SOCIETY, at 6.—With the British Association in Australia: Dr. C. W. Kimmins.

ROYAL SOCIETY OF ARTS, at 4.30.—Tribes of the Brahmaputra Valley: Sir George D. Dunbar, Bart.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—Recent Advances in Oceanography Dr. W. S. Bruce.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—The Criterion of Steel Suitable for Permanent Magnets: Prof. Silvanus P. Thompson.—A Galvanic Cell which Reverses its Polarity when Illuminated: Alan A. Campbell Swinton.—An Investigation on the Photographic Effect of Recoil Atoms: A. B. Wood and A. I. Steven.

MONDAY, FEBRUARY 15.

ROYAL SOCIETY OF ARTS, at 8.—Motor Fuel: Prof. V. B. Lewes.

VICTORIA INSTITUTE, at 4.30.—Traces of a Religious Belief of Primeval Man: Rev. D. Gath Whitley.

TUESDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—Muscle in the Service of Nerve: Prof. C. S. Sherrington.

ILLUMINATING ENGINEERING SOCIETY at 8.—The Development and Design of Lighting Fixtures in Relation to Architecture and Interior Decorations: F. W. Thorpe.

ROYAL STATISTICAL SOCIETY, at 5.15.—The Magnitude of the Population of England and Wales Available for Emigration: Dr. E. C. Snow.

WEDNESDAY, FEBRUARY 17.

ROYAL SOCIETY OF ARTS, at 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.45.—(Student's Section).—Modern Power-House Condensing Plant: A. Arnold.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address: Some of the Micro-biological Problems of the Present War: Prof. G. Sims Woodhead.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Observations of the Upper Atmosphere at Aberdeen by Means of Pilot Balloons: A. E. M. Geddes.—The Influence of Weather Conditions upon the Amounts of Nitric Acid and of Nitrous Acid in the Rainfall at Melbourne, Australia: V. G. Anderson.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Gaseous Combustion at High Pressures: Prof. W. A. Bone and Others.—The Orbits of a Charged Particle Round an Electric and Magnetic Nucleus; Prof. W. M. Hicks.—The Lunar Diurnal Magnetic Variation and its Change with Lunar Distance: S. Chapman.

ROYAL INSTITUTION, at 3.—Struggle of Species: Dr. P. Chalmers Mitchell.

LINNEAN SOCIETY, at 5.—The Action of Light upon Chlorophyll: H. Wager.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The "Cracking" of Oils, with a View to Obtaining Motor Spirit and other Products: W. A. Hall.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—The Visit of the British Association to Australia: Prof. H. E. Armstrong.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.

SATURDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—Recent Researches on Atoms and Ions: Sir J. J. Thomson.

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